Editorial

TWO news reports of recent weeks must have made Australians think some long thoughts.

One dealt with the new version of the Sabre jet fighter which broke through the sound barrier and is claimed to have a phenomenal top speed.

The other concerned flight records over long distances set up by a Canberra jet bomber which will be entered in the forthcoming England-New Zealand air race.

Both these aircraft were built in Australia, and others are coming off the somewhat limited production line.

The wisdom or otherwise of establishing an aircraft industry in Australia is an oft-debated subject, not always I fear conducted against the background of what is good for Australia. In connection with it we must take both a short and a long-time view.

Modern aircraft are extremely costly to make, and more costly in Australia than elsewhere because our market for them is quite small. It is in fact confined largely to Service requirements which are among the most expensive of all. One reason is that, with rapid modern progress, and the fact that Service aircraft become obsolete before they wear out, there isn't much chance of a return for our money. The cessation of hostilities in Korea means that our consumption will be reduced.

The short-term view is that, if Australia were engaged in large-scale hostilities in the near future, we just couldn't make enough aircraft quickly enough to supply our needs, which in any case would have to be integrated with those probably of America for operational efficiency. Our total requirements would be represented by a small quota of American mass production. Therefore we are spending millions of money in something not likely to help much.

The long-term view is that if Australian growth and potential is to proceed towards adequacy and self-sufficiency, we must sooner or later make aircraft just as we make motorcars, particularly as a quota from overseas might not be reliable. It is a costly necessity for which returns must be looked for over a long period, and even anticipated in terms of security as much as in money.

It is probable that the time has now arrived for our long-term ideas to take precedence over our short-term thinking. It does seem reasonable now to assume that the threat of a wide conflict has been at least postponed, and possibly averted for a long time to come, even if we dare not hope for more. Consequently our outlook might well be examined anew from a national viewpoint.

It seems therefore, that the news items referred to have a special significance. Australia's rapid movements in the field of modern technology have been most marked during the last year or two. Can we now afford to halt or to modify our efforts in aviation, an essential pivot round which so many of our efforts, mechanical and social, must revolve?

John Moyle

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OUR COVER PICTURE

Just off the secret list is this new Avro dual-control delta wing research aircraft. It was shown to the public for the first time during the current Farnborough air show. With planes like this, Britain is maintaining her lead in jet aircraft design.

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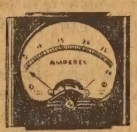

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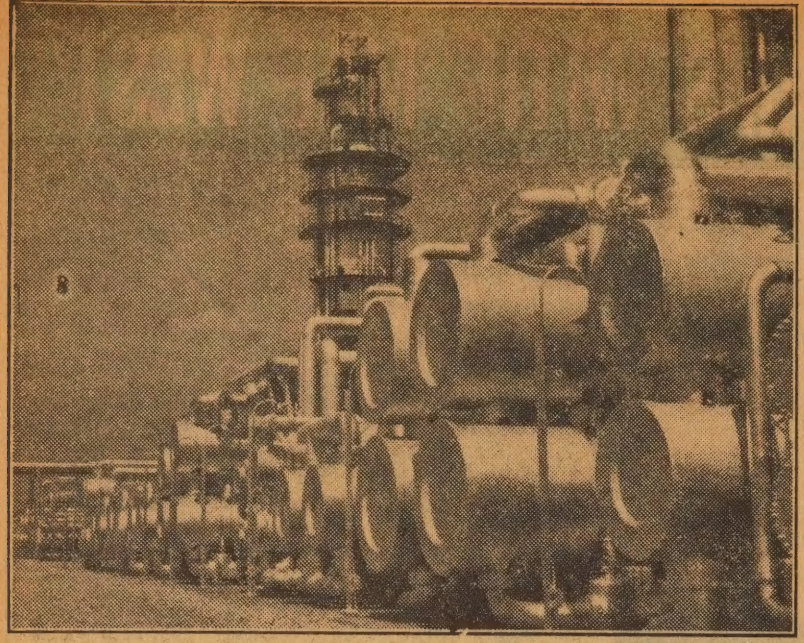
"SARAH" TEAMS WITH "MAE WEST"

"SARAH"—short for "Search and Rescue and Homing" has been adopted by the RAF as a standard radio aid for stranded personnel. Self-contained and waterproof, SARAH attaches to the airman's "MAE WEST" life jacket or his flying suit. It will transmit continuously for 20 hours, guiding planes or ships to the locality. (see page 9)



These are the heat exchangers at the Esso refinery, which distil out the various derivatives from the crude oil as it is pumped ashore. The "cracking" process follows later.

PETROL WON FROM HEAVY OIL

Just over a year ago Britain's first fluid Catalytic cracking plant went on steam at the Esso refinery at Fawley, near Southampton. Forty-seven tons of a finely powdered solid began to circulate every minute through the giant two hundred and sixty-five feet high unit, until it held altogether approximately one thousand tons. But this great mass of catalyst, equivalent to a hundred truck loads, did not behave like a solid; mixed with oil vapors, it flowed like a liquid throughout the cat-cracker to produce from gas oil feed stock more than half-a-million gallons of high-octane petrol every day.

IT is somehow symbolic that a revolutionary new process like catalytic cracking should be controlled by a young man. And Ted Jeffers, who bears the imposing title of Cracking and Light Ends Divisional Supervisor at the Esso Refinery at Fawley, is still only twenty-six.

After taking his degree in chemical engineering in 1947, he joined Esso Petroleum Company and went to work in the Technical Service Department of the old refinery at Fawley.

BIG JOB AHEAD

For three years his progress and abilities were quietly watched and noted down, until one day he was called in by the refinery superintendent and told that he had been chosen to go to America for advanced technical training in new refining techniques. For by 1950, the great new refinery at Fawley was well on the way to completion, and many of the units being built had never existed in England before.

In the United States, Jeffers studied the design and theory of the Fawley cat-cracker and watched the operation of existing units at various refineries throughout the country.

After four months' intensive study he returned to England, arriving back on Christmas Eve, 1950. At Fawley, the cat-cracker was still under construction, and Jeffers' first task was to prepare a training program for the men who would ultimately operate it with him.

These men had a basic knowledge of refining from their work in the old refinery, but they had to be introduced to new instruments and new techniques. For the unit is a sensitive mechanism which needs constant watching and a deep understanding.

All the molecules of petroleum contain the same elements—atoms of hydrogen and atoms of carbon. The molecules in crude oil, however, contain varying numbers of hydrogen and carbon atoms arranged in widely differing patterns.

Some of the molecules contain a large number of atoms. Those with many carbon atoms make up the thicker and heavier components of petroleum, such as asphalt. Others with relatively few atoms make up the lighter and more volatile components, like petrol.

The first step in refining is distillation, which roughly separates the molecules in crude oil according to their size and weight.

The process can be thought of as taking a barrel of gravel containing stones of many different sizes and running it through a series of sieves to sift out the small ones, the next larger, and so on, up to the very largest of all.

As applied to a barrel of crude oil this process "sifts out" such things as gas, petrol, kerosene, heating oil, lubricating oils, heavy oils and bitumen.

But while distillation can separate crude oil into its fractions, it cannot get more of a particular fraction out of the crude than nature put there. And consumers' demands for different products are not necessarily in accord with the proportions nature followed in mixing petroleum's ingredients.

NOT ENOUGH PETROL

For example, if we had to depend on the amount of petrol naturally present in crude oil—20 pc— we could not make nearly enough of it to run the motor cars now on the road.

Fortunately, at about the time that the growing use of motor cars began to sky-rocket the need for petrol, a process was discovered for getting more petrol out of crude than is naturally there. This process is known as cracking.

Earlier we compared distillation to sifting out stones of different sizes from a barrel of gravel. Cracking is comparable to crushing some of the larger stones in order to get more small ones.

Cracking amounts literally to breaking big molecules into little ones, and has made it possible to produce more than twice as much petrol from a barrel of crude oil as can be made by a simple distillation.

The type of cracking which was first invented (and which is still used) employs only heat and pressure, and is called thermal cracking. A later development was catalytic cracking.

THE CATALYST

A catalyst is a substance that causes other substances to change chemically without being changed itself. No one knows precisely why it works—only that it does.

You can try it yourself by holding a lighted match to a lump of sugar. The sugar will begin to melt, but it will not catch fire. If you put the sugar in some cigarette ash, though, and then hold a match to it, it will burn.

Now the ash itself would not burn, or would the sugar by itself, but hen combined the ash acts as a atalyst and changes the sugar's re- ction to flame.

The fluid catalytic cracking pro- ess, which was developed in Esso aboratories, revolutionised cata- tic cracking, for it enables the pro- ess to run continuously for months n end.

Thermal crackers require over- auls about once a month, whereas uid crackers have been on steam or periods up to a year or more; nd these longer periods between verhauls mean lower maintenance osts and a cheaper product.

Fluid catalyst cracking, therefore, now the leading cracking process. ut at the time the Standard Oil De- elopment Company began its ex- eriments with catalytic cracking irteen years ago, fixed-bed or ationary catalytic cracking was the ccepted method.

Initial tests carried out in Esso aboratories were literally on a half- int scale. A number of small units ere set up consisting of catalyst ontainers through which oil vapors ould be passed and from which the acked petrol could be withdrawn.

IUGE PROJECT

Hundreds of catalysts and dozens f oil stocks were tested with results o favorable that it appeared desir- ble to step up operations and to egin thinking how to overcome the ifficulties inherent in the fixed- ed type of operation.

The size of the organisation con- erned with the development of this rocess soon grew from a few tech- ical men to a very large team of ore than a hundred chemists, hemical engineers and mechanical ngineers, who worked together with everal hundred operators, analysts nd mechanics.

Work was then proceeding on the esigns of a large fixed-bed plant, nd in order to miss no chances, it as decided that part of the organ- ation should work on alternative chniques which offered the pro- ise of being better than the fixed- ed type of plant.

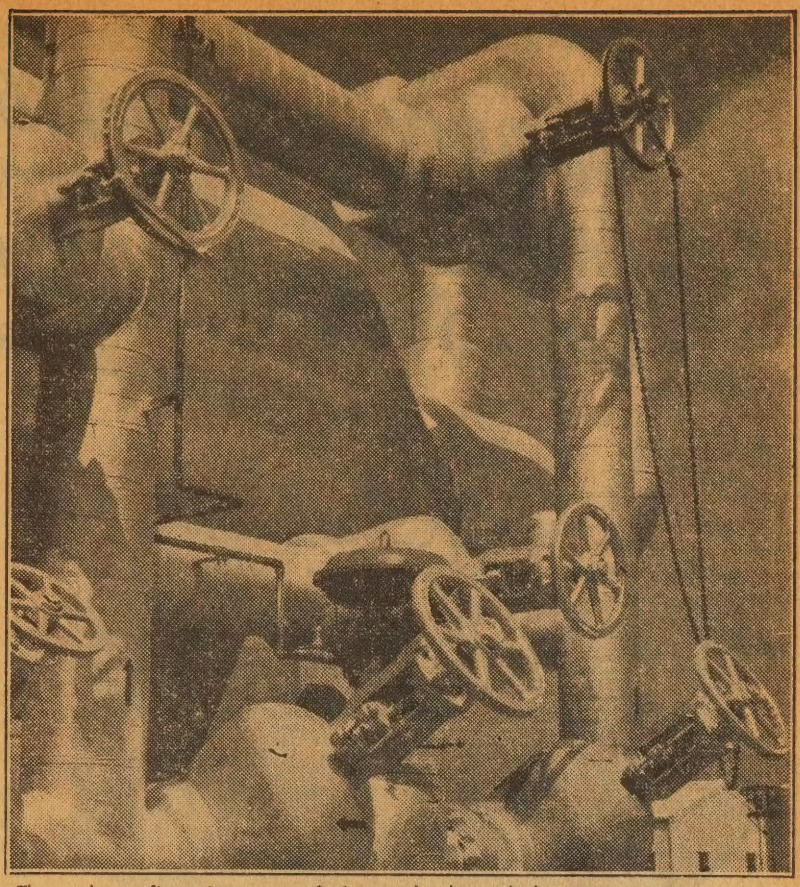
Experiments with these entirely fferent methods were also begun on a very small scale, but it soon be- came apparent that the use of pow- dered catalyst would enable the plant to be more easily built and operated.

The laboratory tests with powder- ed catalyst were soon being scrutin- ised by all the chemists and en- gineers involved, and a 3500-gal- lons-a-day pilot plant using pow- dered catalyst was built.

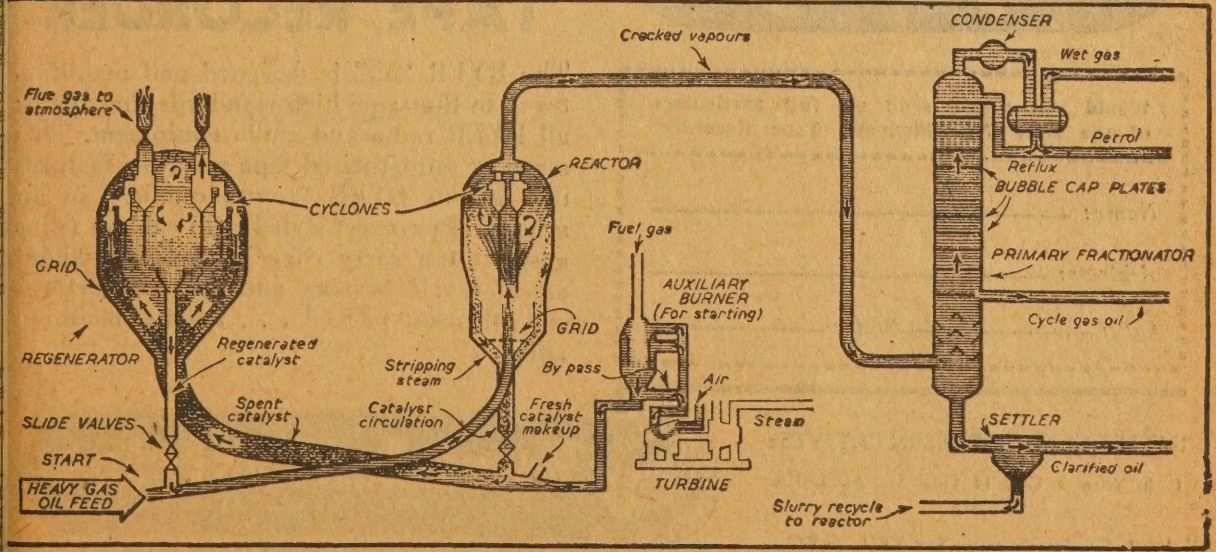
In its operation, catalyst from a hopper was forced by a screw con- veyor into a vaporised oil stream, and the mixture of catalyst and oil vapor was sent through a heated coil where the cracking took place.

Again after several months of in- tensive effort, the engineering de- tails of the process were worked out on this pilot plant and plans for a 450,000 gallons-a-day commercial plant began to go on to the drafting boards.

Just as the construction of the 450,000 gallons-a-day unit was about to begin, there came one of those



The modern refinery is a maze of pipes and valves, which control the flow of crude oil derivatives. Twelve men can run the cracking plant at Esso.



This diagram illustrates the fluid catalytic cracking unit. The fluid catalytic cracking process begins when oil vapour enters the system, picks up regenerated catalyst and flows to the reactor, where cracking takes place. The cracked vapours then go to a fractionating tower for distillation and used catalyst returns to the regenerator.

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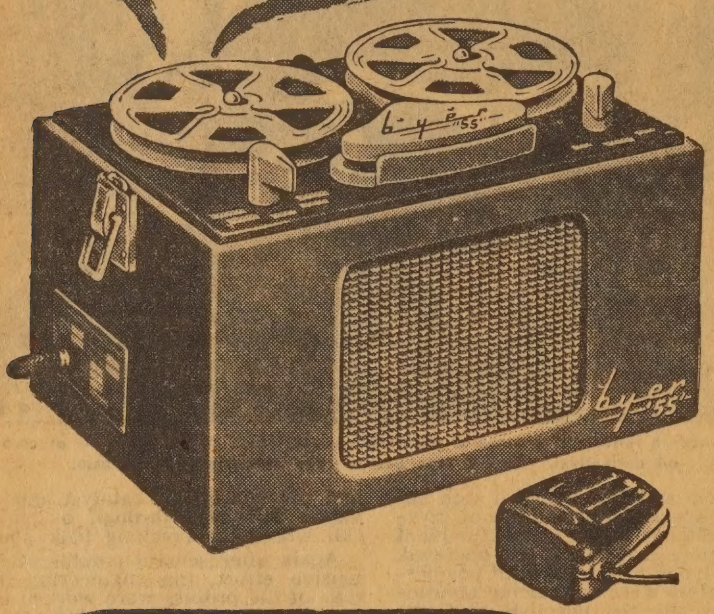

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noments which gladden the hearts of research workers.

By tying together all the work on powdered catalyst, it became clear that if the proper amount of gas (either oil vapors or air or steam) were mixed with the catalyst, it became fluidised and could be handled like water or oil.

Further, it became evident that this "fluid" composed of catalyst and vapor could be made heavier or lighter as desired, simply by changing the amount of vapor added to the catalyst and by controlling the speed at which the new fluid moved.

This technique of changing the density of the fluid could be used through a system of stand-pipes to generate any desired pressure at any particular point in the system, and by proper manipulation could circulate the catalyst through the units without moving parts.

VITAL DISCOVERY

Here was a really revolutionary idea. It was recognised at once that by the time these new principles were put into operation, still further simplification and ease of operation were bound to result.

Again the 3500 gallons-a-day pilot plant was completely rebuilt to put these new principles into effect.

The engineering factors were established in a relatively short operation of the pilot plant and development moved directly to the building of the 450,000 gallon-a-day unit.

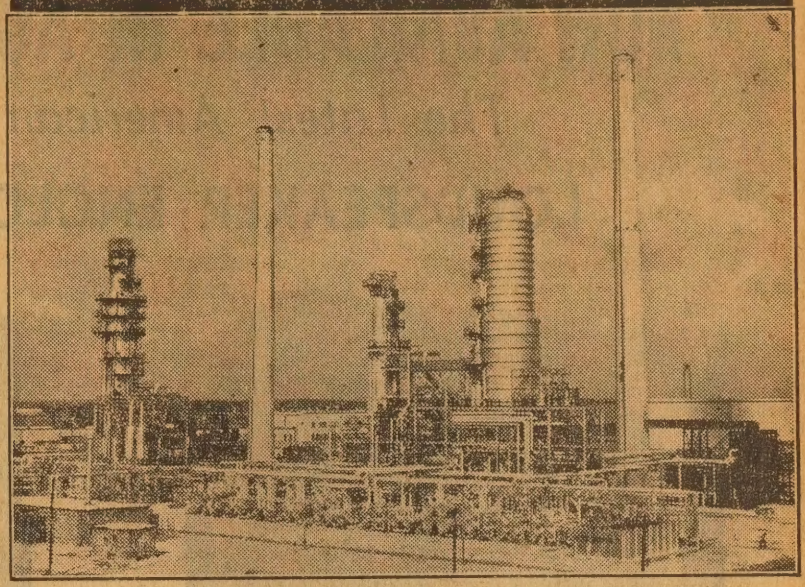
Despite the risk involved, the first large unit proved completely successful and development was hurried on to its goal, the designing and constructing of large commercial units.

The extent of engineering work needed to design a big commercial plant may be judged from the fact that one of the first of them took 25,000 man-hours of engineering work alone.

Contributions to the development work have also been made by many other oil companies; and the patents which cover the fluid process have since been made available to the entire industry.

The fluid process grew in a remarkably short while from the laboratory to the first commercial plant, which went into operation in May

LARGEST REFINERY IN EUROPE



Part of the Esso oil refinery at Fawley—the largest and most modern in Europe. The ringed tower is part of a huge still. Chimney stacks dispose of fumes and polluted air.

1942, at Esso's Baton Rouge refinery.

The first commercial unit was more than 100 times larger than the previous pilot plants. In spite of the growth in size, however, the development of the process has been marked by a continuous simplification. In a number of its plants, the fluid process leads the other catalytic cracking processes by substantial margins.

Construction of the vast cat-cracker at Fawley began in April, 1950, when 30,000 cubic feet of concrete were poured all in one day to form its foundation, and it was completed and on steam two months ahead of schedule toward the end of 1951.

MAELSTROM INSIDE

Although the cracker's exterior shows no movement, a veritable storm takes place inside its huge vessels. Vast quantities of vaporised oil, air and powdered catalyst circulate at high temperatures through miles of pipes and reactors.

After being in use for a while (the average particle of catalyst makes it way round the complete circuit every ten minutes) the fine grains of catalyst become coated with carbon removed from the oil. The catalyst is then inactive.

By being whirled into a regenerator where the carbon is burned off, however, the catalyst is reactivated and thus can be used over and over again. The regenerator liberates heat equivalent to 15 tons of coal every hour, and this is used to raise the temperature of the oil to the cracking temperature.

Any surplus heat is used for steam raising.

Although its intake is approximately 1-million gallons a day, the instrumentation of the unit is so skilfully designed as to be largely self-controlling and only 12 men are needed to supervise the running of the plant.

FEW ATTENDANTS

But once the cat-cracker is in operation, it runs continuously night and day for many months on end, and so there are four shifts of these 12 men, three on eight hours of duty each day and one shift off duty.

Ted Jeffers, the supervisor, and Leonard Keel, his assistant, work only on the day shift, but they are on 24-hour call on alternate days.

The feed stock for the cat-cracker is a heavy gas oil, which normally forms part of the fuel oil used for bunkering ships and of which there is a surplus after normal distillation.

By subjecting this gas oil to catalytic cracking, however, 65 pc of it is transformed into far more valuable and far more necessary high-octane petrol, while the remainder emerges as gas oil, which is not reprocessed, but is used as a blend stock in the manufacture of industrial and marine fuel oils.

A CANADIAN WOODEN "SAUCER"

A WOODEN model of the first known "Flying Saucer" has been completed at a Canadian aircraft factory.

The plane is called the Omega, because its shape resembles that of the Greek letter.

It is the first aircraft to use the gyroscopic principle of stability in flight at supersonic speeds.

The Chicago Tribune reports that the secret project has been in progress for more than a year at the A. V. Roe (Avro) factory at Malton, Ontario.

In charge is John Frost, an English aircraft designer who previously worked with Frank Whittle, inventor of the jet engine.

Neither the Royal Canadian Air Force nor Avro would discuss the project.

"Our mouths are taped," said a factory official.

"We cannot talk about the saucer, or even confirm that it exists."

Few have seen Avro's Omega except those engaged in its construction.

The Tribune reports that the mock-up model is about 40 feet in diameter.

The pilot would sit in a plastic enclosed space in the centre.

A jet engine would revolve around a vertical axis to create gyroscopic stability.

Take-off would be assisted by rocket propulsion.

According to design, the Omega should reach unprecedented speeds in the air, with ability to make quick turns on the level, without the sharp banks of winged planes.

Air intakes are provided on the leading edges of the Omega with jet exhausts in the rear.

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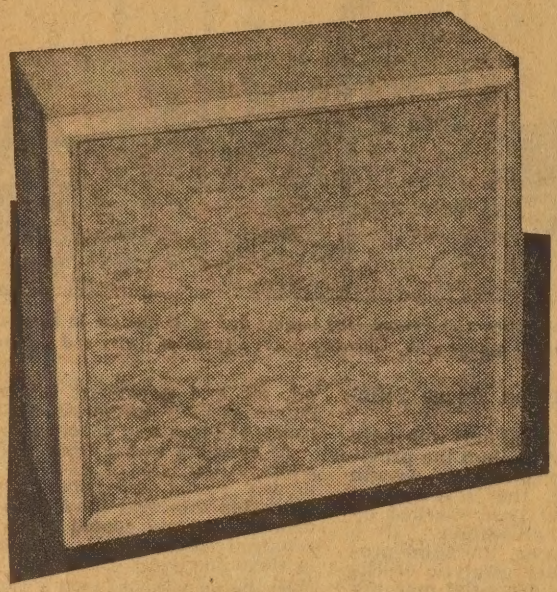

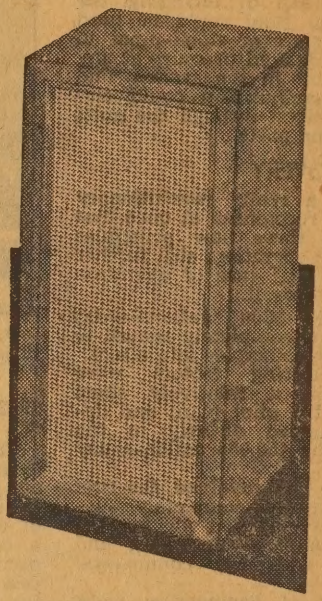

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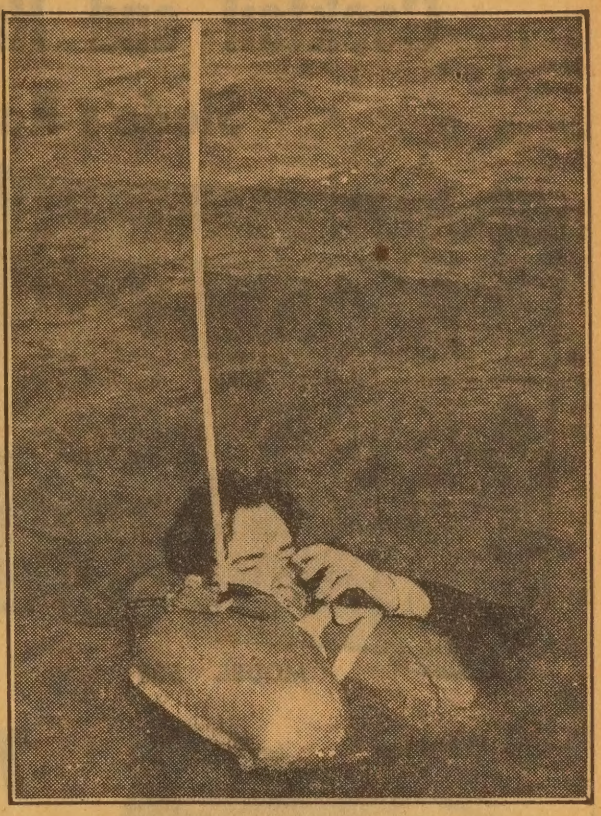
NEW AID FOR STRANDED FLIERS

SARAH—short for Search And Rescue And Homing—is a new British invention which will revolutionise air-sea and land rescue operations. With it, air-crash survivors, shipwrecked seamen and stranded personnel in jungles, mountain country and in desert can be located by day or night and in any weather.



An airman demonstrates the new "Search and Rescue and Homing" device, which the RAF has christened "Sarah". The aerial rides clear of the water, supported on the flier's standard pattern "Mae West" life preserver—made famous during World War II. The rest of the equipment, including the battery, is submerged but is sealed against water penetration, even under moderate pressure.

)NE high-flying aircraft can now search the same area as ten w-flying aircraft using older ethods. The RAF have adopted ARAH, which will be the standard scue equipment by the end of 1954.

SARAH is a radio beacon ,weighg only 20 ounces and measuring n by 1in square. This, together ith a 32-ounce battery, is attached the survivor's "Mae West" or ying suit.

All the stranded man has to do to pull a small ring which releases 31in flexible aerial and starts the eacon transmitting the signal that ill guide the searching ship or airaft.

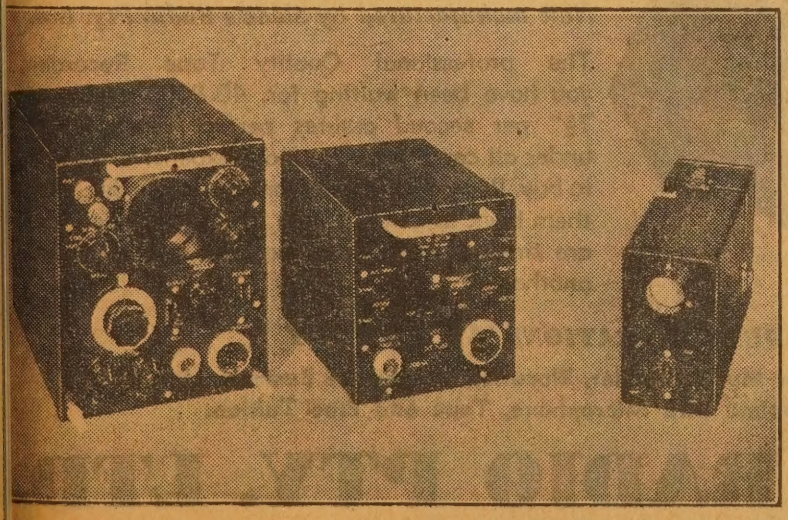
In the searching craft the signals e picked up by twin antenna and splayed on a cathode ray tube. hen the rescue craft is heading traight for the transmitting beacon e signal from each antenna will be splayed as "spikes" of equal length either side of a central trace.

The recue craft thus "homes" on the stranded man or alternatively, steering another course obtains a cond bearing and hence a "fix".

As the searching aircraft passes er the beacon the signal trace will sappear. Smoke signals or flares e then dropped and the position dioed to helicopters or ships, to mplete the rescue.

The tiny transmitter will signal ntinuously for 20 hours with a aximum range of 66 miles to an rcraft at 10,000 feet. A distress signal at sea can thus be picked up by an aircraft within an area of 10,000 square miles. Satisfactory signals—at smaller ranges—can be received by aircraft up to 60,000 feet.

Surface ships fitted with the 24lb SARAH receiving appartus will pick up the beacon's signals at a range of six miles.



Here is the type of equipment carried by the rescue units— whether patrol aircraft, helicopters or surface vessels. The receiver is on the left, the power pack in the centre. Research is progressing into the design of smaller equipment and a prototype of a combined miniature receiver and power unit is shown at the right.

A special coding device incorporated in the transmitter produces pulse variations that enable the operator in the searching craft to identify any number of beacons in the same area.

A 12-ounce two-way speech unit can also be incorporated in the stranded man's transmission unit to provide short-range verbal communication to assist the final stages of the rescue. Although stranded personnel can thus talk to the rescuing craft, they cannot waste their batteries by talking to one another as speech units are not "compatible".

Research on SARAH, which was designed and produced by Ultra Electric Ltd., Western Av., London, W3, has been going on for five years. Tests have been carried out in specially heated steam rooms at 158 deg. Fahrenheit and the transmitter has been embedded in ice at 58 deg. of frost.

SARAH is waterproof and in its present form will withstand water pressure to a depth of 50 feet.

More than 200 delegates of the North Atlantic Treaty Organisation and the European Defence Community were recently invited to see SARAH at the Royal Aircraft Establishment at Farnborough. The equipment has also been on show to the US Navy, the US Army and the Royal Canadian Air Force.

Only recently taken off the secret list, SARAH will shortly be submitted for approval at the next meeting of the International Convention for the Saving of Life at Sea.

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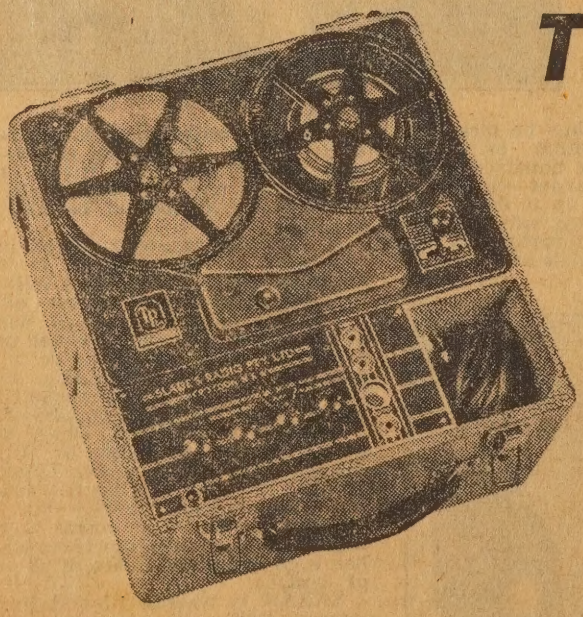
Makes available to radio dealers and home constructors a full range of cockail and radiogram cabinets. Made from best quality maple and Italian walnut veneers, finished with a brilliant piano finish.

Also in blonde & rosewood finish.

Labyrinth to suit 12in Speakers available.



Top Quality at Low Cost

The Slade Sound Mirror Tape Recorder

Now manufactured by Slade's Radio Pty. Ltd.

The professional Quality Tape Recorder you have been waiting for. 40-8000 cycles at 7½" per second assures perfect reproduction under all conditions. No more expensive records to buy. Record your own from the Radio Set, play them back as often as you like. Erase when you are tired of any particular tune and re-record another.

DAILY DEMONSTRATIONS AT FACTORY

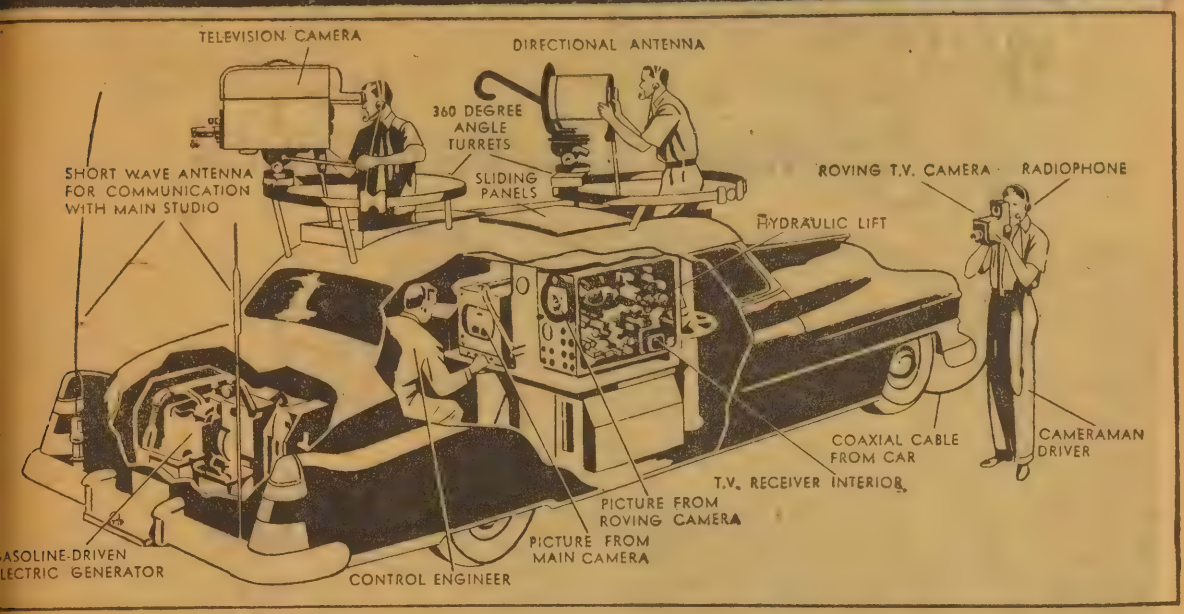
The ideal recorder for Music Teacher, Elocution Teacher or Business Man.
Price £146 Complete with Microphone, Tape and Free Tuition.

SLADE'S RADIO PTY. LTD

LANG ST., CROYDON, N.S.W.

UJ5381 **Established 30 years** **UJ5382**

CAR IS A ROVING TV STATION



Faced with the problem of sending their cameras wherever a newsreel car could go, NBC television engineers have come up with a complete TV station, packed inside a regular Cadillac sedan. The new 62,000-dollar auto, with turrets mounted atop its hood will soon be a familiar sight in the streets of New York.

KE other big TV concerns, the NBC network has long had its bile units but they are as big as ving vans. They rapidly get im-bilised in heavy traffic and can-negotiate narrow lanes or muddy ks.

eeently, when an airliner crashed the river at Washington, the big could not venture on to the river s by the side of the road. It had e parked and long cables run out the cameras, the power trailer so on. Similar difficulties at-ded the spectacular train crash Union Central.

T GOOD ENOUGH

hooting from ground level at the of the cables, the cameras, ording to engineers, "got some ll shots of Homburg hats and d heads".

he answer to the problem clearly in a smaller vehicle, into which ld be packed as much minia-sed equipment and as many lities as possible.

Vith the co-operation of General tors Engineers, a standard 7-senger Cadillac was pulled off the duction line and its routine in-or fittings removed.

oles were cut in the roof and turret rails fixed around them he at the front, the other at the . Trolleys riding the rails now y a regular television camera a special directional high fre-ncy antenna system.

tanding on a hydraulically ered platform below roof level, camera operator can focus down the scene of interest, if necessary while the car is moving. Meanwhile, up front, the antenna man keeps the transmitting aerial focused accurately on the distant receiving aerial atop a high building. From here, the signals are routed to the regular transmitter.

For more intimate close-ups, a third member of the crew—or the driver—has a miniature Vidicon camera which he can carry into the crowd, trailing a length of cable from the car.

Down inside the vehicle, behind blacked-out windows, an operator sits facing a mass of compact, miniaturised studio equipment. He can watch the scenes from the two cameras on monitor tubes, fade and dissolve the respective scenes, control crowd noises and commentary and despatch a properly monitored signal to the parent station.

A regular short-wave channel maintains direct speech contact with the station, allowing directions to be passed without interference with the program.

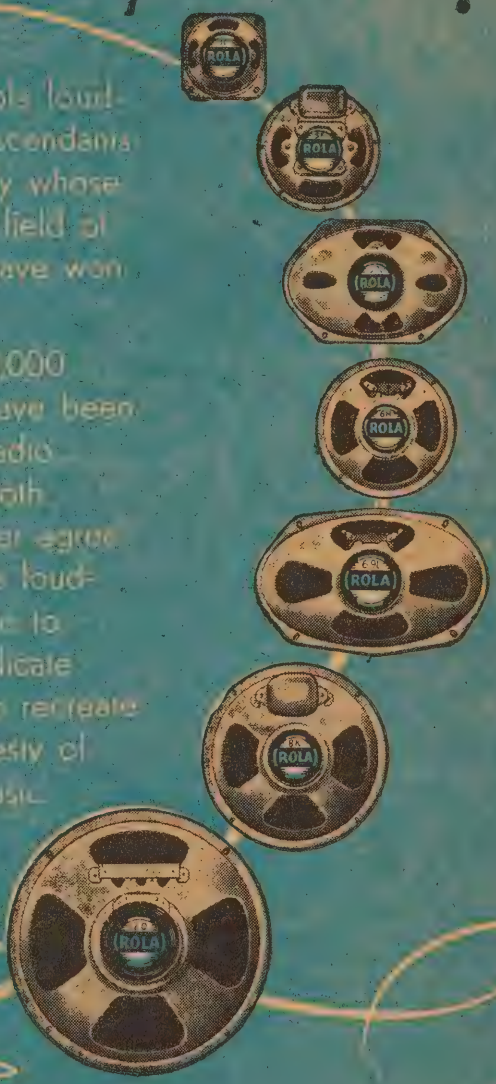
And power for all this? Inside the regular boot, especially sound-proofed, a compact gasoline generating set purrs away silently and without vibration to power the ton of electronic equipment packed into the cab.

A close-up view of the new NBC car showing camera and aerial on their respective turrets. Note the blacked out rear windows.

Aristocrats of Sound Reproduction!

Current model Rola loudspeakers are the descendants of an illustrious family whose performances in the field of reproduced sound have won wide acclaim.

More than 3,000,000 Rola loudspeakers have been fitted to Australian radio receivers because both manufacturer and user agree that only with a Rola loudspeaker is it possible to reproduce every delicate tonal shading and so recreate the beauty and majesty of the world's great music.



W. & G. GENDERS PTY. LTD.

A. E. HARRIES

AND ALL LEADING WHOLESALERS

IT'S ALL DONE WITH MIRRORS . . .

The old stage wisecrack about the use of mirrors is strangely appropriate in laboratories handling radioactive materials. Mirrors and such allied devices allow workers to observe what is going on without being exposed to dangerous radiation.

By J. D. MORTON

N the interests of safety, workers use water and glass filters, mirrs and periscopes.

Most versatile and efficient are eriscopes which are constructed and sed for hundreds of purposes. They ncorporate a system of mirrors, plus ptical lenses. Variable magnification is achieved by mounting rotating urrets on the periscopes, then conrolling the turrets by remote means o select lenses of different focal engths and magnifying powers as eeded.

Ingenious mechanical equipment as been built into these periscopes o make them easy to position. Some ave double heads to aid the viewer n seeing objects from various angles.

Other periscopes are portable and an be broken down and reassembled o see around corners, inside pipes nd up stair wells. Periscopes equiped with synchronised searchlights re used to inspect large tanks and nside enclosed areas.

OOR PHOTOGRAPHS

Ordinary periscopes can be used ith a variety of optical instruments, ut are not generally practical for king photographs. They distort nages because their lenses are not f photographic quality.

Better pictures can be taken inside ese closed-off areas, experts say, y placing a camera inside the area, r by constructing special periscopes ith camera-type lenses.

Mirrors are used less extensively an periscopes by atomic workers. nce they reflect light, but not danerous atomic radiation, mirrors are sed for viewing behind barriers and r taking photographs. Mirrors also e used in many installations where ore than one person at one time ust see behind a barrier.

A big disadvantage in using mirrs is the distortion of distances etween workers and the area where ork is being done. They also are pensive and easily damaged. At esent their greatest use is in viewg or photographing areas behind w walls.

ATER FILTERS

Water often is used in the atomic ant as an effective filtering agent r lethal radiation. In many jobs, orkers manipulate radioactive subances submerged in tanks of water. Workers get a clear view of the nk bottom because the high refracre index of water makes the bottom em closer than it actually is.

Glass-bottomed wooden boxes ating on a water surface furnish a ooth viewing screen in cases where e water becomes agitated.

Binoculars and periscopes are used magnify objects under water and obtain an improved perspective. Glass also is used as an effective tering agent. Large, foot-thick winws are used in some operations. ey are made of plate glass in layers either assembled dry or laminated with liquid cement to reduce internal reflections. Plateglass, fortunately, offers protection from radiation equivalent to the same thickness of concrete.

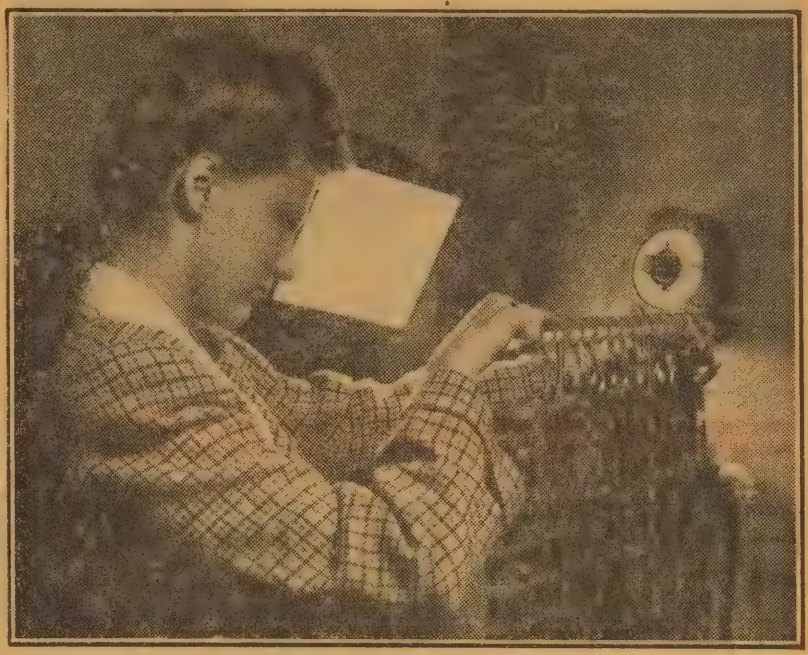
Recently, a type of glass containing large amounts of lead oxide was developed to offer better protection from atomic radiation than the same thickness of steel.

Glass filters containing a layer of water six feet thick have been constructed, but they transmit only about 25 pc of the available light.

Colorless metallic salts of heavy metals have been used in an effort to increase the shielding effect of water-filled cells in glass. So far, zinc bromide has proved most successful. Other substances are too expensive, poisonous, corrosive or they tend to crystallise after a drop in temperature.

Excellent photographs have been taken through thick glass windows. And microscopes with magnifying powers up to 1500 times normal size have been used with such windows.

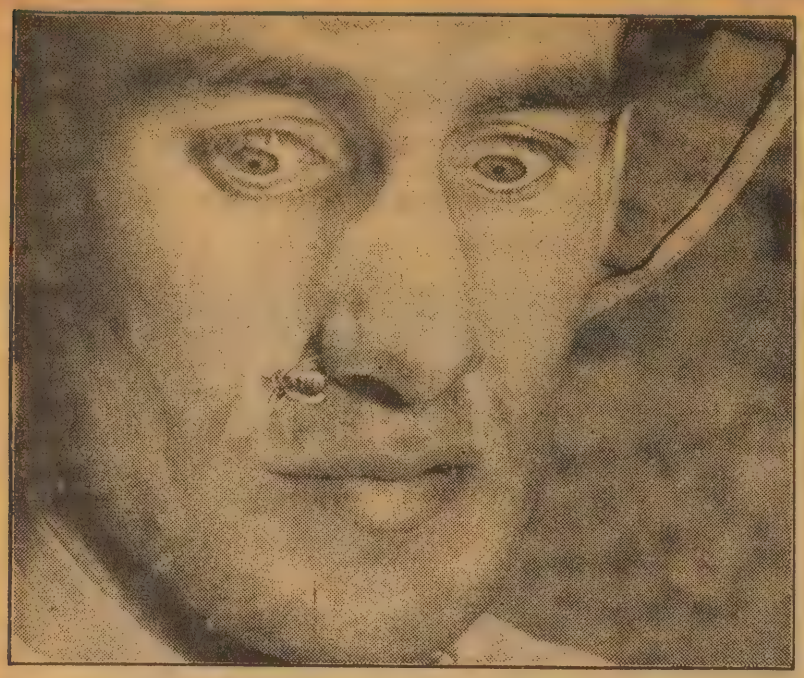
Hundreds of different kinds of viewers have been developed to meet specific needs and all have accomplished their chief purpose—to keep the worker comfortably removed from his work, yet optically near the task at hand.



In Canada's Chalk River research laboratories special films are used to check employees each week for radiation effects. Picture shows a rack of "health films" being developed indicating the condition of 250 employees.

AN ATOMIC DRY CELL with a gas electrolyte activated by nuclear radiation has been invented by Philip E. Ohmart, president and director of research of the Ohmart Corporation, Cincinnati, Ohio. The inventor found that a measurable unidirectional current flowed between two air-insulated electrodes of lead and gold when the air surrounding them was exposed to radiation from a microscopic quantity of radium. Reversing the connections reversed the direction of current flow, proving that ionization of the gas electrolyte by beta radiation was responsible for the current. As a double check, Mr. Ohmart built an airtight cell and connected it to a vacuum pump. As the air was exhausted the current dropped steadily, reached zero, and then reversed itself, when the cell was almost completely evacuated.

Further research led to the adoption of colloidal graphite (Aquadag) instead of gold as the positive element. An experimental model develops enough power to run a tiny electric motor for demonstration purposes, but the principal uses for the Ohmart "atomic" battery at present are in radioactivity-detection instruments. ("Radio-Electronics")



The subject of Cal. Walters' article this month is "on the nose" or almost so. A sting wouldn't mean much to this apiarist but it would probably cost the bee his life.

TALKING OF BEES AND THING

Whilst the strange habits of insects have commanded attention for thousands of years it only in modern times that any attempt has been made systematically to investigate them The results are intriguing.

by Calvin Walters

THERE is a well-known proverb which exhorts us to "Go to the ant, thou sluggard; consider her ways and be wise". Aside from the fact that recent research has thrown grave doubts on the wisdom of ants, one could take a grim view of that exhortation.

Who's a sluggard anyway? Notice also that the proverb says "consider HER ways . . ." Is a lady ant the only one endowed with wisdom? What about the old man? This business of imagining that the female of any species is the wise one is obnoxious to us men.

HE, SHE AND IT

The inference is there in the proverb, no matter which way you look at it. Would not it have been much more tactful to say "consider ITS ways . . ."? But no that's not what it says. One can only assume that the proverb was written by a woman or by a man who was afraid of his wife.

Not like me, for instance. No woman can frighten me. I say what I think. Women must be kept in their place. All this "Yes, dear", "Very well, dear", "Certainly, dear". Bah! Crickey, here comes the wife, I'll have to cover this up or it's the "dog house" for me. Can't let her read this!

Now, about these insects. Do they have brains? How do they find their way about? Can they hear? All these matters have been closely studied in recent years with some very interesting disclosures.

Insects certainly have brains and the size of the brain depends on what the insect is. For instance, a worker bee has a larger brain than a queen bee or a drone — a fact which lends support to the argument about the wisdom of women.

As for the drones not having a large brain, this is a bit hard to understand, for I will swear that the human drone often has more brains than the worker. To devise a means of earning a living without working surely requires a lot of hard thinking and some of the drones I h seen don't seem very hard up.

The brain of a worker bee is ab 170th the volume of its body. the other hand the brain of almost brainless beetle one see ponds is only 1/14,000th the siz its body. It hasn't enough sense to in out of the wet.

There are several comparati large nerve centres in inseets which the brain is the largest which is situated where one wo expect it to be — in the head. brain is connected to the other cen by nerves running under the ins Thus these are NOT where would expect them to be, nam along the back.

TWO BRAINS!

There is a sort of supplement brain fixed below the main br and behind the mouth. These brains work in co-ordination so the reflex actions of the thorax abdominal nerves come at the p per time.

An expert can mess about w these brains with some peculiar sults. For instance, the brain can removed leaving only the supplem tary brain. Under these condit the insect will "go walkabout" walk and walk until it is comple done in because it doesn't know w to stop.

A bee similarly deprived of main brain will spend many ho cleaning itself quite without no Other insects will keep on trying lay eggs when there are none to

All this is because it is the br which controls. The supplement brain provides the stimulus. Th with no brain and only the supp mentary brain, the stimulus will in constant action but there will no control.

WALKS WITHOUT HEAD

The leg muscles of insects are c trolled by nerves in the thorax. T is why an insect can walk with its head. It stumbles around and slow in its action because remov its head also removes the stimulat provided by the supplementary br

The eyesight of insects has b studied in great detail in the light modern knowledge of wavelen and some surprising results h been elicited.

In general the adult insect is p sessed of two different kinds of e much as it has two different bra These eyes are compound and simp Compound eyes are placed one each side of the head and the sim eyes (usually three in number) on the top of the head.

Bees and wasps and winged a have both kinds of eyes.

The purpose of the compound eye s to distinguish light intensity and o collect or register images much as ur own eyes do. Each section or eye" of the compound eye consists f a lens and a crystalline cone be- ind it. Each eye collects light and ocuses it on to its own retina so that he retina in each "eyelet" does not erceive an image but only a record f light intensity.

As this mechanism is present in ach "eyelet" the total picture pre- ented to the brain is in the form of picture similar to a half tone re- roduction of a photograph in this nagazine.

If you look closely at such a pic- ure it will be seen to consist of dots f varying sizes. The size of these lots is governed by the amount of ight. Similarly if you consider each iot to represent the "image" from ach "eyelet" in a compound eye, t will readily be seen what sort f a picture is built up in the in- ects brain.

THE SIMPLE EYES

The purpose of the simple eyes s to provide a stimulation in much he same lines as the supplement- ry brain. If the simple eyes are overed the insect is slow to re- pond to changes in light intensity. onversely if the compound eyes re covered and the simple eyes eft uncovered the insect is almost f not entirely blind.

The image presented to the brain s somewhat blurred and it is appar- nt that most insects just know that omething is there without know- ng what it is. It treats everything t "sees" as an enemy unless, as it loes, it has the power to distinguish riends by other means.

However, by insect standards, ants nd bees have well developed eyes nd can recognise form reasonably vell. They use this faculty in re- ognising objects which can be used s landmarks on their foraging ex- peditions.

The faculty for recognising colors s well developed in bees and this as been proved in a variety of ways.

COULD SEE COLORS

One such experiment used saucers f water, each saucer being placed n a different colored square of aper. Only one of the saucers con- ained sweetened water and when he bee once found this it invariably eturned to that saucer. This was ot accomplished by memorising the ocation because when the saucer ogether with its colored paper was emoved to another position the bee would return directly to that saucer.

This experiment also proved that he bee could tell the color by the avelength because, when a color imilar in intensity to the sweetened he was used under the unsweeten- d saucers the bee would always elect the original color with its weetened water.

To prove that the bee did not elect the sweetened water by some bscure instinct the saucers were mptied and dried and replaced on heir colored papers. The bee would till come to the saucer and paper hich first contained the sweetened ater.

Most insects are sensitive to ultra-violet rays but show little response to colors of a longer wavelength than orange-red.

Just a lonely little ant on the head of a pin. A pin-up girl—who knows?

Bees cannot distinguish between red and black but both ants and bees are particularly sensitive to ultra-violet. Even a dark violet glass which is opaque to a human being can be transparent enough to a bee or ant to permit the passage of sufficient ultra-violet light for an ant or a bee to see.

If a white object which does not reflect ultra-violet light has on it a pattern in white which reflects ultra-violet light a bee can readily distinguish the pattern. Bees as mentioned above cannot recognise red but can select certain red flowers probably because these reflect ultra-violet light.

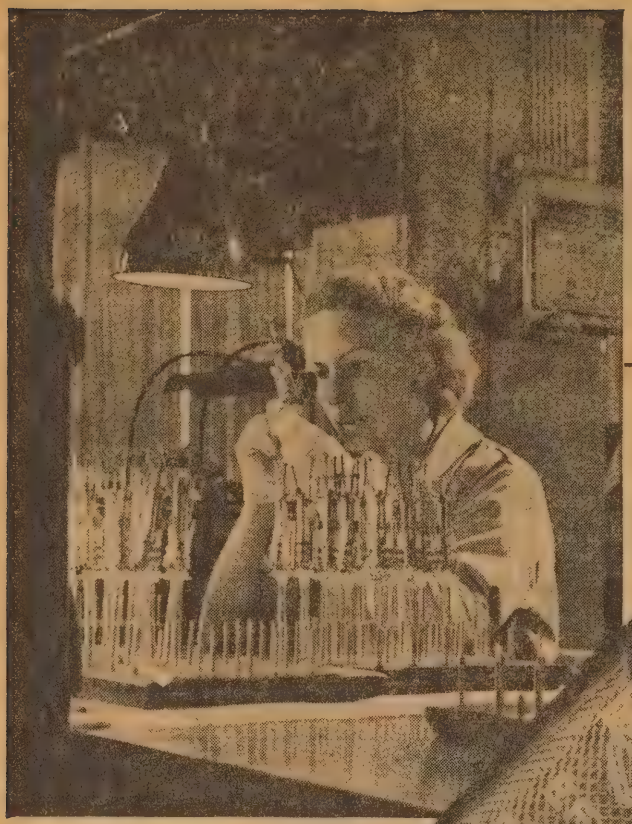
A peculiar feature about a bee is its curiosity regarding patterns. It seems to prefer complicated patterns rather than simple figures such as a cross or circle. A bee will almost likely ignore a dish of food placed over a paper on which a cross or simple pattern is drawn and will prowl around an empty dish set over a complicated pattern such as an eight or 10 sided figure.

LIKE MOVING FLOWERS

If you observe bees hovering around a flowering bush, it will be seen that they mostly alight on those flowers which are moving in the breeze. Their sight is greatly dependent on movement.

Can insects hear sounds? Experiments show that some hear sounds directly and some detect sounds by vibration on their bodies. Grasshoppers hear directly and it is a strange circumstance that their ears are located at the base of the abdomen. Crickets have the organ of hearing in slits in their front legs. A strange place indeed. Bees however, do not appear to make any response to sounds notwithstanding their noisy doings inside the hive.

We fervently trust there's no other explanation for Calvin Walters' sudden interest in entomolgy. Our picture shows two "sand beetles" (in foreground) on the sands by an English riverside.



The inspection of Mullard picture tube gun assemblies.

SEEN but not HEARD

VOLTAGE AMPLIFYING PENTODE EF86

Low-noise pentode primarily intended for use in high-gain R.C. coupled A.F. voltage amplifier stages.

CHARACTERISTICS

V_h	6.3	V
I_h	0.2	A
C_{aut}	5.5	μμF
C_{in}	4.0	μμF
C_{a-g1}	0.025	μμF
V_a	250	V
V_{g2}	140	V
I_a	3	mA
I_{g2}	0.55	mA
V_{g1}	−2	V
V_{g3}	0	V
g_m	1.85	mA/V
r_a	2.5	MΩ
μ_{g1-g2}	38	

OPERATING CONDITIONS

AS R.C. COUPLED PENTODE A.F. AMPLIFIER			
V_b	250	250	V
R_a	†0.1	†0.22	MΩ
R_{g2}	†0.39	†1.0	MΩ
R_k	†1.0	†2.2	kΩ
*R_{g1}	330	680	kΩ
I_k	2.05	0.95	mA
V_{out}/V_{in}	112	180	

* Grid resistor of following valve.
† Values ± 10%.

Mullard

The Mullard EF86 is an all-glass, low noise valve, with the universally accepted single-ended 9-pin technique. The total generated noise expressed in terms of an input to the grid is **less than 5 micro volts.**

Incorporating the best features of the earlier low noise, low hum, low microphony types, the Mullard EF86, like **the picture tube,** is truly a **valve that is seen but not heard.**

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M

Some ants are responsive to sounds
th as a wave and as a vibration
their bodies. Termites are ex-
emely sensitive to mechanical
bration and it is a fact that when
enemy appears at hand the soldier
rmites warn the others within
e gloomy galleries by banging
eir heads against the walls of the
lleries.

Certain ants make a few noises
hough we don't often hear them.
ey are able to do this by scraping
kind of file situated between two
gments of the abdomen. This
ise seems to be heard well enough
all the tribe because when dan-
r threatens everyone acts together
e a team.

HEIR FEET SMELL!

As regards taste and smell, the
es, wasps and ants have it well
veloped—in their feet, antennae
d mouths. Bees drink water as
eryone will notice if a wet rag
bag is lying around where bees
ngregate. When a bee is filled
ith drink and accidentally dips its
gs into sweetened water it will stick
t its tongue and start in for a
ed. In bees it is the antennae which
stinguish between sweet, sour and
tter and the mouth distinguishes
lt.

That bees can detect and distin-
ish odors is also proven by ex-
riment. In fact it has been estab-
hed that bees recognise flowers
ore by smell than by sight. The
me applies to ants who are a very
ssy crowd when it comes to select-
g the type of timber to get into.
ie mouth of an ant is richly en-
wed with sense cells.

It is the sense of smell which an
t uses in the art of making a trail
the sugar basin or cake box in the
pboard.

The first ant which finds it lays
wn a scent trail. The ants which
llow later increase the strength of
e scent with result that in due
urse there are millions of ants
eading the trail.

MEAN TRICK

You can throw them off the scent
mewhat by wiping a finger across
e trail, whereupon the ants will be
rown into utter confusion.

But how does an ant know whether
is coming or going? The ques-
on has not yet been answered.
iere appears to be some method by
hich an ant can orientate himself.
e certainly can recognise land-
arks but how does he know whether
is landmark is on the way to or
the way fro?

Finding direction by light has a
t to do with this direction. One
ecies of ant suitable for experi-
ents, the Lasius Niger or aphis
nding ant uses the sun for direc-
on finding. If one of these ants is
ocked when on his way some-
iere and prevented from moving
r an hour or so, it will, when re-
ased, move off in a direction which
different from the first one by
e number of degrees the sun has
oved.

This ant is thrown into confusion
an artificial light which it has
en using on one side of the path
quickly moved to the other side.
ie ant turns around and careers
the opposite direction.

Ants which learn direction when
ey are hungry will only go in that
rection if hungry. If an artificial
ail from nest to food is reversed
so that it runs from food to nest
the ant has to learn it all over again.

The same applies if the light source lies so that an obstacle lies directly in the path. The ant will climb over the obstacle no matter how hard the effort, rather than go around. It must keep the light directly in view. Similarly it will fall down a depression even if it meant only an inch or two to go around it. These things it will do even while carrying a "tit-bit" many times larger than itself.

There are other sense organs which are provided in insects. Hairs spines, bumps on the body and so on can perceive sensations. One has not much chance of swatting a fly with the hand because the air pressure between the hand and the fly's body is felt by the latter.

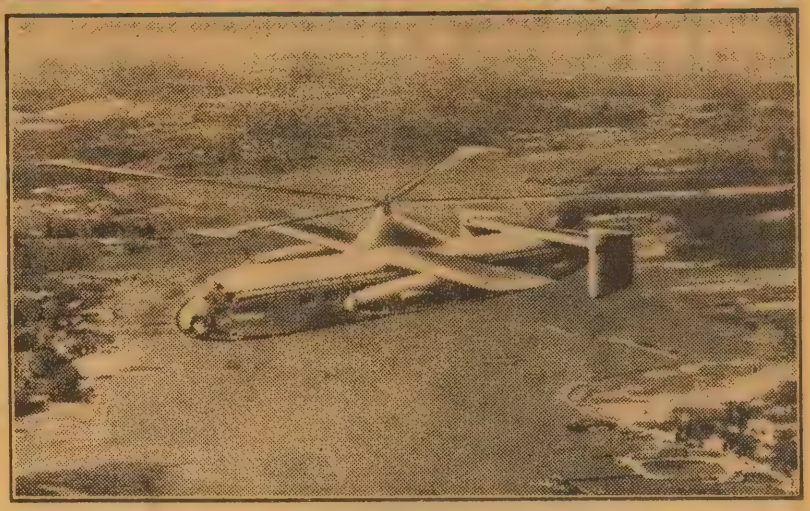
If the hand is moved very slowly toward the fly and then suddenly advanced it will possibly succeed. Fly swats are usually made from gauze wire to allow the air to escape through.

An insect is possessed of small bumps which are the seat of nerve endings. These act as detectors of atmospheric pressure, water pressure or bending. One group of organs called the Johnston's organ conveys messages to the brain when an ant is feeling its way by means of its antennae. When the antennae are bent the Johnston's organ detects the slightest movement.

There are organs for detecting changes in temperature and humidity but these have not as yet been elucidated.

An insect, therefore, is a highly organised piece of mechanism whose actions are mainly based on reflex actions motivated by means of sensitive organs. The problem is being slowly unravelled and much more light thrown on this interesting subject.

A 40-PASSENGER HELICOPTER



Here's an artist's impression of the Fairey Aviation Company's "Rotodyne", a large helicopter powered by two Napier Eland propeller turbines and fitted with tip-driven jet rotors. The Rotodyne is expected to cruise at a much higher speed than other helicopters. The British Ministry of Supply have ordered a research model. The Rotodyne, still in the drawing board stage, will seat 40-50 passengers, or can be used as a ferry. Large loading doors at the tail will facilitate loading. Fairays claim the Rotodyne will hotly challenge the fixed-wing Dakota.

NEW TRANSISTOR TECHNIQUE

TUBELESS radio and television receivers came a step closer to the world's living rooms with a recent announcement by the General Electric Research Laboratory of a new and revolutionary means of producing germanium for transistors.

Transistors, which require tiny bars of the element germanium, are the new devices capable of performing many of the electronic chores now done by more complicated vacuum tubes like those in radio and television sets.

Dr. Robert N. Hall, a young physicist in the laboratory has developed a means for producing as many as 100 wafer-thin layers of specially treated germanium in a six-inch ingot. Other methods produce only one or two of these vital layers. Dr. Hall emphasises, however, that the new method is still in the laboratory stage.

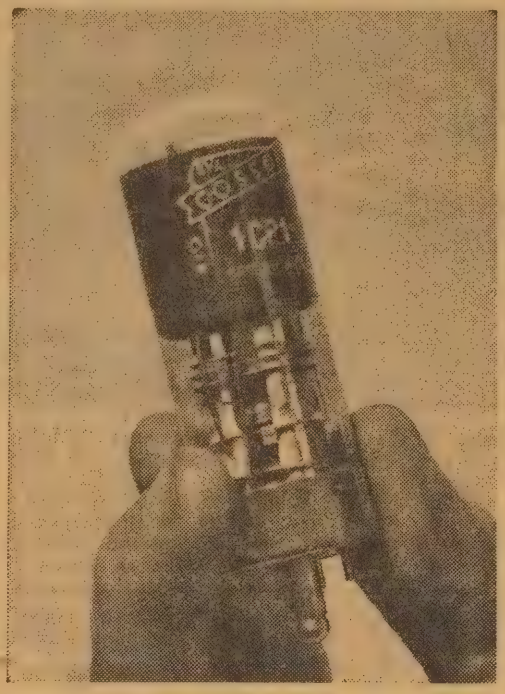
Each of these layers contains germanium mixed with a trace of gallium. They are separated by thicker regions of germanium containing minute amounts of antimony.

One section of the "gallium-doped" layer in each transistor does the work of the grid in a vacuum tube, Dr. Hall explained. The "antimony-doped" layers take the place of the cathode and plate in a tube.

Using the new method, several thousand transistors can be produced from each ingot. The method will improve transistor performance and is expected to cut production costs. As a result, the new technique may permit the use of transistors for the first time in television sets.

COSSOR

MINIATURE CATHODE RAY TUBE TYPE ICPI



DATA

Overall length	100 m.ms.
Max. diameter	30 m.ms.
Screen diameter	25 m.ms.
Base	Lock-in B8G.
Heater volts	6.3
Heater current	0.6 amps.
Anode Volts	500/800
Max. grid bias	-21/-32 Volts.
Deflection	Electrostatic
Focus	Automatic
Screen	Green, short persistence

IDEAL FOR MINIATURE OSCILLOGRAPHS

The COSSOR Type ICPI Miniature Cathode Ray Tube is a new ingenious development intended for use in small portable oscillographs or as an inbuilt monitor tube with a screen diameter of approximately 1 inch.

AUTOMATIC FOCUSING simplifies circuitry and only one anode potential is required.

Low operating potentials and high heater/cathode insulation eliminates power supply difficulties and, for simple display purposes, the grid bias is easily obtained by inserting a resistance in the cathode circuit.

Complete details supplied upon request.

AVAILABLE NOW Complete with base from all Radio and Electrical Wholesalers and

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Technical Review

T-V BROADCAST OF CORONATION IN FOUR COUNTRIES

The exchange of television programmes on an international basis was brought a step nearer to reality with the large-scale broadcast of the Coronation scenes to viewers in four countries —Great Britain, France, Holland and Western Germany.

LL told, some 2000 miles of radio links and coaxial cable were used o carry the program to the various adiating stations.

In England itself, four major out-oing channels carried the program rom the originating centre at the lexandra Palace. Two of these ere permanent cable links to high-owered regional stations, firstly to Venvoe in Wales, secondly to Sutton oldfield and thence to Holme Moss.

From Holme Moss, the program as relayed through a series of icrowave links to a low-powered tation near Newcastle and a high-owered station serving the Edin-urgh area, at Kirk O'Shotts.

Across the Irish Sea, signals picked p direct from Kirk O'Shotts were e-broadcast through a low-powered ransmitter at Glencairn, near Bel-ast.

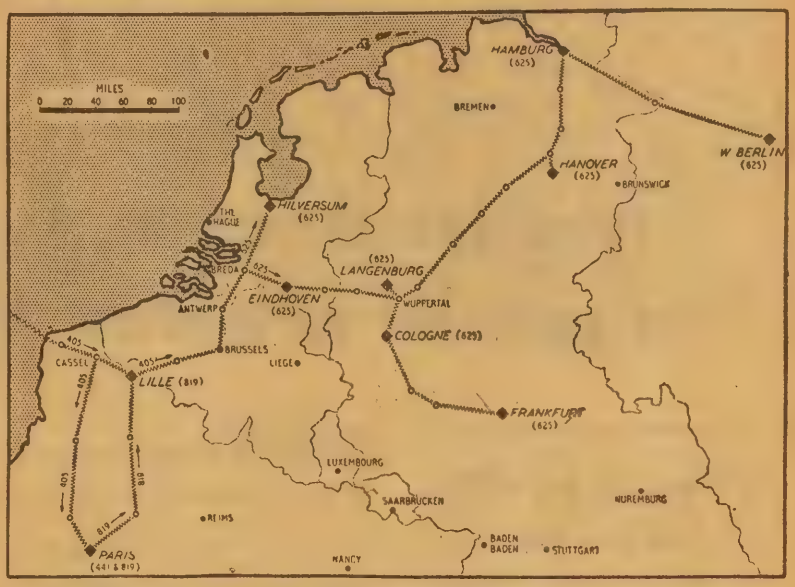
INK TO EUROPE

A similar direct pickup and re-roadcast from Alexandra Palace erved the Brighton area, while a icrowave link, passing through Dover, fed the signals across the hannel and into the European conti-ent.

For the Continental relay the ision signal was transmitted from ondon to France by relay stations rovided by Standard Telephones & ables Ltd. It was picked up at a oint near Cap Blanc Nez, Calais, nd re-transmitted to Cassel.

It is seen from the map that the 05-line signal was carried by the rench PTT and Radio-diffusion et elevision Francaises south from assel to Paris for conversion to 441 nd 819 lines for re-transmission by aris and Lille.

The 405-line signal was also car-ed east from Cassel to Lille where was conveyed over a chain of



Centimetre-wave links covering some 1,200 miles formed the chain for the re-transmission of the BBC's Coronation Day broadcasts by Continental television stations. Against each transmitter is indicated the standard employed. (Wireless World)

centimetre-wave links across Belgium, which had not yet a television service.

It was, however, planned to monitor the transmission in Brussels where a limited number of people could see the 405-line picture probably on large-screen equipment.

The key point for the 625-line transmissions by the Dutch and West German stations was Breda, where the Philips organisation had set up a conversion unit.

The 625-line signal was taken by direct links to Hilversum and Eindhoven and via four centimetre-wave relays to Wuppertal to be fed into the permanent network recently inaugurated by the Nordwestdeutsche Runfunk to link the five NWDR television stations.

The longest hop in this chain of relay stations was that linking the Berlin transmitter with the last station in Western Germany—a distance of nearly 100 miles.. The frequency used for this hop was 196.25 Mc/s.

In addition to the five NWDR stations the Frankfurt transmitter in the American Zone and the Weinbiet station near Baden Baden (French Zone) was radiating the 625-line transmission.

The complementary sound transmissions were carried by cable to the Continent, where broadcasting organisations had the choice of two of the following three circuits: 1, background sound free from any commentary; 2, English commentary; and 3, French commentary.

It was, therefore, possible for Dutch and German commentators to hear the English or French commentary which they could then translate for superimposition on the background sound.

Streamlined Periscopes for Submarines

STREAMLINED PERISCOPES for U.S. Navy submarines will allow the underwater ship-killers to move faster without detection while scanning the sea for targets.

Experiments in the David Taylor Model Basin tow tank at Carderock, Md., revealed that streamlining periscopes cut down tell-tale splashing, or pluming, of the "up" periscope on the fast-moving submarine. Sleek lines also keep the periscope from vibrating, a problem which has "blinded" the sub's "eye" at high speeds.

Streamlined periscopes now are being installed on the Navy's front-line subs by engineers of the Edo Corporation, College Point, N. Y. A company spokesman said also that problems "aggravated by the development of the snorkel" have been licked.

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Fine Wire

Precision drawn in Australia to conform to highest World Standar

TECHNICAL SERVICE

If you have any problems concerning fine wire or wiring, phone or write to the Philips office in your State. Philips advisory service is at your disposal, and you are assured of the co-operation of Philips Engineers and production staff—Special wires, outside the normal range, will be produced to meet your own specifications and requirements.

PHILIPS have long enjoyed a world-wide reputation second to n as manufacturers of highest quality fine electrical wire.

Now, at the Philips Hendon works, skilled technicians operating the mos modern precision equipment of its type, are producing fine wire that maintains that reputation.

A uniform high standard of quality is ensured by careful control during all stages of manufacture. From selection of raw materials to finished product, elaborate testing methods are constantly employed. Finally, eve spool is tested for dimensions, pinholes, break-down voltage and enamel quality. The range of Philips Australian-made fine wires includes all common sizes of single core, high frequency Litz wire, multi-strand flexible, and others within the fine wire range; write for illustrated folde containing complete details and specifications.

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STRAIN GAUGE USES PRINTED CIRCUIT TECHNIQUE

The printed circuit technique, which has found increasing application in miniaturised electronic equipment, has now been applied to the production of electronic strain gauges, capable of measuring stress in a variety of structures.

IN the conventional strain gauges, a zig-zag pattern of fine resistance wire, the diameter of which rarely exceeds one-thousandth of an inch, is mounted between strips of paper. This unit is cemented to the structure to be tested, and considerable care taken to waterproof it.

The gauge extends with the test piece when loaded, and not only does it increase in length, but also the diameter is reduced. As a result, the electrical resistance of the wire increases in proportion to the dimensonal changes. A suitable apparatus is employed to measure the change in resistance, and it may be calibrated directly so as to indicate the strain.

Another advantage of the new gauges is that instead of mounting them in paper, they are mounted in very thin lacquer film, having excellent mechanical and electrical properties. This gives the foil element robustness and flexibility and, since there are no intervening layers of paper, the transmssion of strain from the specimen to the gauge is effected more positively than with wire gauges.

Araldite adhesive is used for mounting the gauge on the specimen. This is a thermo-setting plastic cement, which is cured at a temperature of about 100 deg. C. applied for 20 minutes. The heat may be applied either externally or by passing a current of from about 150 to 350 milli-amps for the required period of time through the gauge element itself.

Possibly the most important advantage of the foil gauge is that the ratio of contact surface area to the volume of the resistance element is relatively high. As a result, the heat dissipation characteristics of the new gauge, and hence its current carrying capacity, is many times that of the wire element. The sensitivity of any resistance strain gauge is directly proportional to the current flowing through it.

The method of production of these gauges is so flexible that any conceivable 2-dimensional pattern may be produced with ease. This flexibility has led to the development of two variants of the common pattern of gauge element.

The first is the torque gauge. In this variant the slots in the strip of foil, instead of being arranged so that they are open alternately from each end, are etched alternately from each side at 45 deg. to the major axes of the strip.

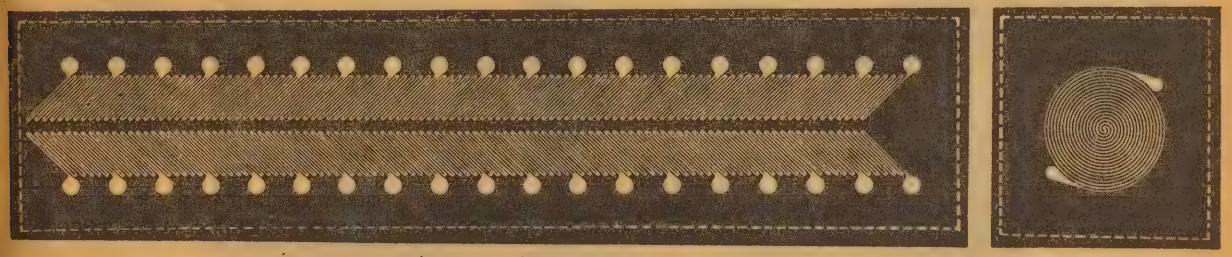
Two strips are mounted side by side around the periphery of the test piece, with the slots on one set at an angle of 90 deg. to the slots on the other. This arrangement takes the place of the two elements, normally employed when a conventional wire gauge is used, and it balances out any longitudinal stresses superimposed on the torque.

A different application of the foil principle is the diaphragm gauge. This is designed for use on relatively stiff diaphragms with small total deflections, since under these conditions the strain behavior is not too complex.

In this form, the gauge may be used to measure pressure, either static or pulsating, as well as strains. A double-spiral pattern is employed, the spiral being wound inwardly toward the centre and then doubling back on itself to the periphery again. This pattern integrates the circumferential strain over the area of the diaphragm, and thus makes the most efficient use of the gauge material and the strain response of the diaphragm.

Another design is being developed for very flexible diaphragms. It consists of two parallel linear patterns in the central tensile zone, coupled with two radial patterns in the outer compressive zones. The whole configuration is to be used as a four-gauge bridge of high power sensitivity.

Only a few applications of this type of gauge have been described. However, there must be many more which could be devised to suit special requirements. Because of the simplicity of the manufacturing process and the ease with which different patterns may be produced, there would seem to be little doubt that further development of the foil type of gauge will be made in the near future.—(From The Automobile Engineer and Flight.)



Two sketches indicating types of printed strain gauge referred to in the article. On the left is the twin torque gauge while, on the right, is the special spiral gauge for measuring diaphragm stress. The metallic strip is depicted as white.

A fairly high degree of skill is called for in the production of the wire gauges. The wire is either wound on, and then cemented to, a thin backing paper, or wound on to a paper former to make a coil which is then flattened and the whole assembly is cemented to a paper backing.

Finally, the ends of the wire have to be soldered or spot welded to relatively heavy lead-out wires or soldering tags.

Then the gauge is reinforced with one or more strips of paper.

SIMPLER METHOD

A much simpler method of production is employed with the new gauges. They are made from metal foil slotted alternately from each end so as to form a continuous zig-zag or looped strip which, apart from its rectangular section, is of much the same form as the normal circular section wire arrangement.

The pattern is first printed on the plain foil, the ink used being acid resistant. Then the unprinted portion is etched away.

At the end of each loop, the effective width of the foil is approximately 3-64in, so that the cross-section is relatively large, and therefore has a low resistance. This reduces any inaccuracies which might possibly arise from end resistance effects and also gives more efficient transmisson of the strain of the specimen to the element.

Where the two leads of the measuring instrument circuit are attached, the width of the strip of foil is increased to about 1-8in, so that leads may be soldered directly on to it.

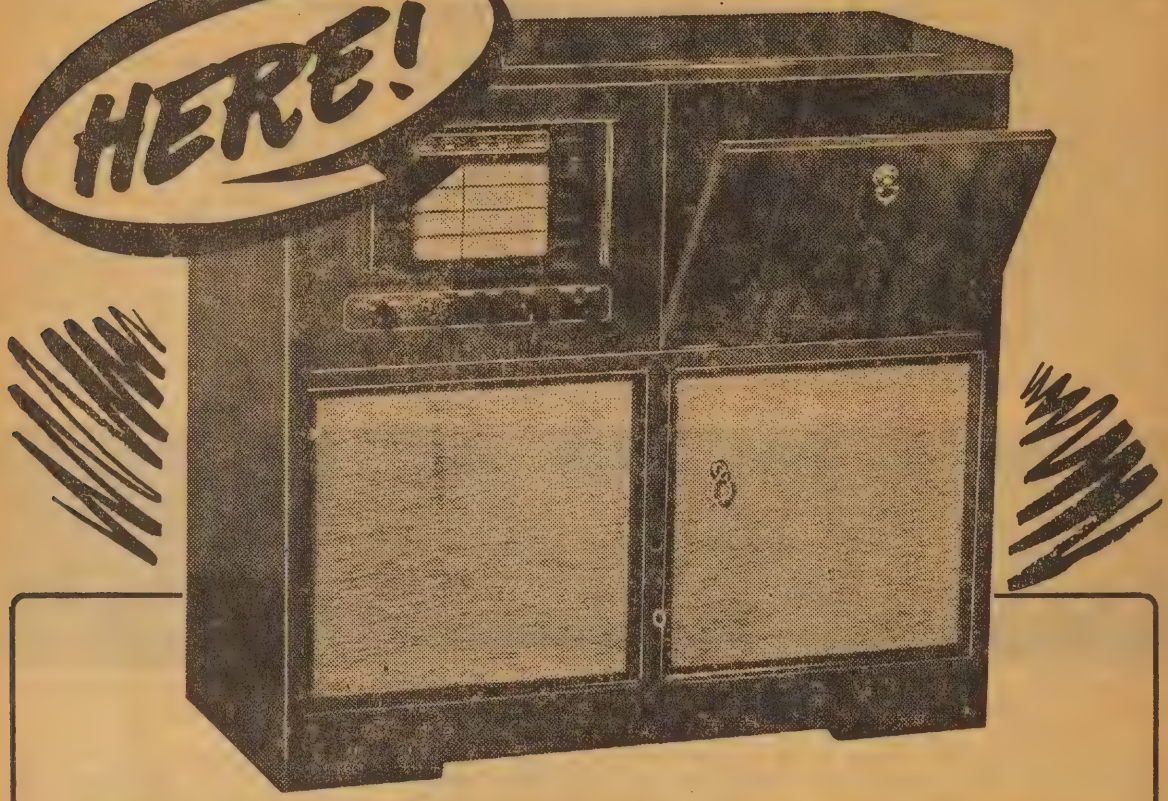
PRIVATELY OWNED ATOM PLANT

NORTH AMERICAN Aviation has announced plans for construction of an experimental atomic power plant. The company's announcement is in line with President Eisenhower's recent suggestion that industry be encouraged to develop atomic power for peacetime use.

The aviation company disclosed that it expects to build a ten-million dollar pilot plant as an initial step in its program to develop atomic power for its own use.

A company official, J. H. Kindelberger, said all the essential engineering problems have been solved. The company's ultimate goal is a 60-million dollar plant in which nuclear fission of only ten pounds of uranium daily would equal the power production of the U.S. Government's big Hoover Dam.

YOUR NAME GOES HERE!



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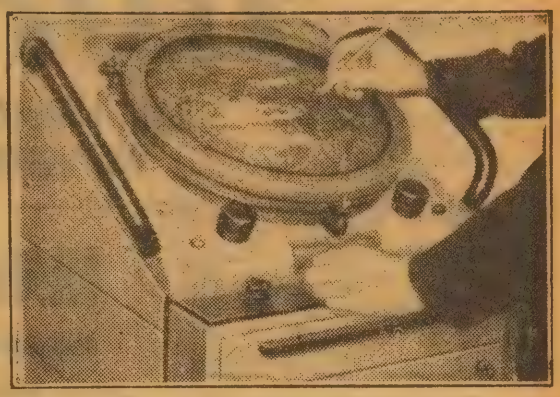
MANUFACTURERS TO THE TRADE ONLY

RADAR COURSES PLOTTED ON A SPECIAL SCREEN

The Powergraph Position Tracker, an advanced development of the Radiomarine Corporation of America, enables a ship's navigator to trace the movement of other vessels directly on the radar scope itself, thus maintaining a continuous plot to show his course in relation to the courses of other vessels.

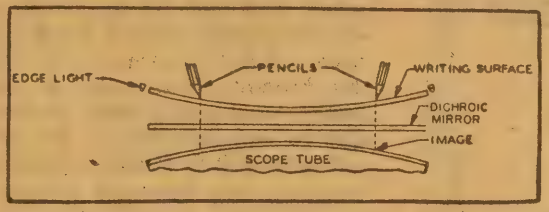


Illustrating the simplicity of the new radar plotting device. The risk of error is greatly reduced since positions are marked directly on the display.

PRIOR to this latest development, the plotting of the course of a radar target required additional personnel and cumbersome equipment, with inevitably inaccurate results. After numerous attempts to evolve an effective plotting method, experts concluded that the only logical solution was to plot the target's course directly on the scope.

To do this it was obvious that means would have to be found to eliminate the optical error called parallax. Parallax is a fault which is introduced when the navigator, standing in front of the radar scope, changes his viewing position so that the pin-point reflection of the target "pip" seems to have shifted to one side or the other.

The powergraph position tracker is permanently mounted on the radar indicator directly over the scope tube. It comprises an edge-lighted concave glass writing surface and a special dichroic (two-color) mirror. This mirror has the unique property of reflecting downward as a red image on the scope any wax pencil marking that is placed on the writing surface.



Illustrating the principle of the new device. A color-sensitive mirror and edge-lit writing surface minimises parallax error and separates visually the display from the plot marks.

At the same time the mirror permits the normal yellow glow of the radar targets to pass upward to the observer's eye. In this way, the tracker provides a convenient method of recording the relative positions of objects within range of the radar. New marks are made as the target vessel changes location, thus facilitating the working out of courses, speeds, passing distances or the solution of other navigational situations.

VERY USEFUL

The use of the dichroic mirror is a notable stride in marine navigational plotting. Much work has been done with these mirrors in the development of color television cameras but it is believed that the powergraph position tracker represents the first application of these color filtering mirrors to a radar plotting device.

The logic behind the gradual evolution of the powergraph position tracker becomes apparent when previous plotting methods are analysed. With the early true plot method, the radar findings had to be relayed to another person who recorded them on a sheet.

Next came the relative plot or manoeuvring board method in which the investigating ship was used as the basis for the problem. This provided a more substantial base for calculations.

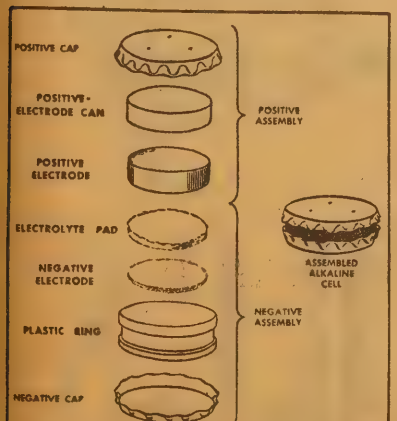
The United States navy took the next step with its swifter, more efficient plotting system which embodied the plastic manoeuvring board. This system utilised a series of concentric and parallel lines drawn directly on the plotting surface of the board. A still later innovation, the navy's dead reckoning tracer, moved the plotting surface over the mark designating the ship's position in direct relation to her speed.

NEW TYPE CELLS GIVE LONG LIFE

More than a million dollars and three years of engineering research preceded the development of a new alkaline "B" radio battery now being marketed by the Tube Department of RCA Victor Division. The new battery is nearly 25 pc smaller than comparable types, yet offers double-playing capacity for the modern radio set designed around it.

THE 67½-volt "B" battery, specifically designed for use in personal portable radios, is the first radio dry battery to utilise the alkaline-cell principle which heretofore had been applied successfully only to wet-type, non-portable batteries.

The alkaline principle makes possible a more efficient utilisation of the cell's active materials. Accordingly, it is possible to reduce the size of both cell and battery.



This sketch shows the elements of the new RCA "crown type" cell. The manufacturers claim double playing time from a set designed around the batteries.

The "crown type" cell employed in the new battery is a compact, self-contained unit which resembles two shallow soda bottle caps placed near together, measures only 0.9 inch in diameter and 0.23 inch high.

Sandwiched between the two "bottle caps," within a protective plastic ring, are the positive electrode can, the positive and negative electrodes, and the electrolyte pad. One cap serves as the positive terminal; the other, the negative.

The physical shape of the "crown type" cell makes for simplicity and compactness in constructing the multiple-cell stacks around which batteries are built. The stacks are held in place in a paper tube. The metal outside shell is crimped over a hard fibre insulator which, in turn, puts pressure on the cell stacks.

NUMBER OF CELLS

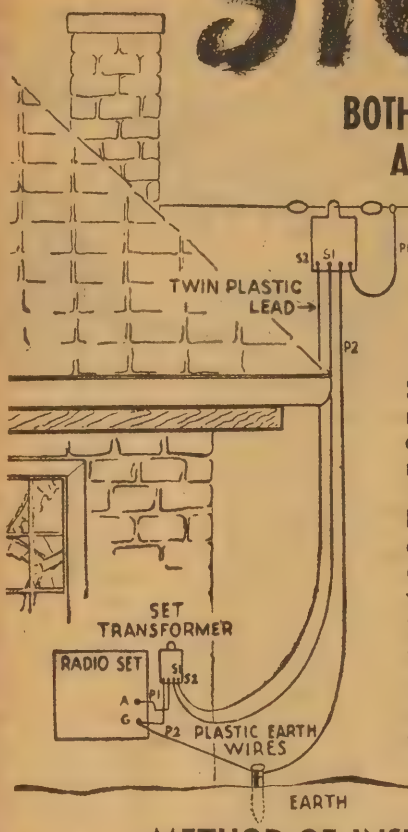
A small jumper strip makes the connection between the stacks.

The number of cell stacks that go into a battery depend upon its electrical requirements. In the RCA alkaline "B" battery, two stacks of these exclusive "crown type" cells are combined to provide the correct voltage output.

After manufacture of the individual cells, each cell is placed in storage for a short time to allow it to become stabilised.

STOP NOISE IN YOUR SET

BOTH MANMADE NOISES RIDING YOUR INCOMING SIGNAL AND MANMADE NOISES RIDING YOUR POWER LINE



NEW R.C.S. DEVELOPMENT

COMPLETELY ELIMINATES NOISE!

Solves many a listener's problem. Restricted frequency range and lack of sensitivity due to poor listening levels are frequently caused by manmade interference. Servicemen will tell you that quite a large percentage of sets that are brought in as noisy are faultless. The real trouble-background noises and chatter and poor performance, is due to bad installation and interference entering both the aerial and R.F. stages of the circuit.

You can now eliminate outside manmade interference and hear, for the first time, the true reproduction qualities of your receiver.

It you cannot obtain R.C.S. aerial or line filters from your retailer, please write direct to R.C.S. and we will arrange for your retailer to receive supplies.

METHOD OF INSTALLATION OF R.C.S. AERIAL FILTER AF21 WITH TRANSMISSION LINE LEAD-IN

MASTS It is essential that the mast or masts be as far away as possible from the electricity mains, so that the flat top will be as near a right angle position as possible, but the masts should have clearance of at least 30ft from metallic objects, such as roofing, tanks, etc. Guy wires also should not be run close to these conductors. If the pole is to be guyed on to any part of the house, it is advisable to use rope. The aerial can be any length from 50 to 150ft. A long flat top is desirable, but not essential. If space is not available, a single pole of the greatest height with a small flat top or a metallic cage may be used. The aerial transformer will then be placed a few feet above the base of the pole and the transmission line run along a fence to the house.

Earths

The provision of good earths at both mast and receiver is extremely important.

Aerial Transformer

The aerial transformer should be suspended from the flat top of the aerial and a lead from the aerial flat top soldered to its terminal "P.1". "P.2" is soldered to an earth wire taken to the bottom of the pole, using a 3/20 gauge soft drawn copper wire. The earth to which this wire is connected may be a piece of galvanised iron piping driven from 4 to 6ft into the ground.

Set Transformer

The set transformer should be mounted as close to the aerial and earth terminals of the receiver as possible. Leads from "P.1" and "P.2" of the set transformer are connected to aerial and earth terminals of the receiver.

Transmission Line

From the terminals "S.1" and "S.2" of the aerial transformer, a transmission line is taken to the terminals "S.1" and "S.2" of the set transformer. The transmission line can consist of Flat Twin plastic flex. This flex, if desired, can be twisted by attaching one end to a fence with the other end fitted to a brace or drill revolving until the desired twist is attained.

Erect the aerial proper in a noise free zone or position. The transmission line should not pick up noise or signal and therefore can be run through the noise zone, back to the radio set. The transmission line can be of several hundred feet in length, if necessary.

For noise entering the power mains, use R.C.S. Line Filters, type LF20, without condensers or LF20C with condensers.

If the load exceeds ¾ and is not more than 2 amps, then use type LF24 or LF24C.

R.C.S.

RADIO PTY. LTD.,
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NEWS AND VIEWS OF THE MONTH

The search for 3D

WHILE 3D appears to have faded for the time being from the headlines and from the world's cinema screens, hopeful experimenters in many countries are still trying to solve the problem of 3D without glasses.

One approach, from France, strikes at the accepted principles of 3D presentation and attempts to present the added dimension simultaneously to both eyes.

Local attempts to do much the same thing by a different method resulted, according to the audience, in nothing more than a jittery image. However, we can let French writer Pierre Devaux tell the story of this new development:

"Since the days of Leonardo da Vinci, it has always been said that to see the third dimension is to see, with both eyes, two different images of the same object.

"This principle, which has seduced thousands of inventors, is incorrect. The double image is not necessary. What matters, in seeing a statue in relief, for example, is to see, besides the frontal image, small areas on the sides, such as the ears of the statue.

"For this purpose, we have only to move slightly from right to left. If we moved quickly enough — even with a single eye — the different images of the statue would be superimposed in our brain, exactly like the two images of ordinary stereoscopy, but with infinitely more sharpness.

"In practice, our heads are not capable of such rapid oscillating motion. But a French inventor has succeeded in obtaining it very easily by means of a lens moving over a device in the form of the arc of a circle, photographing the subject from several different angles during the taking of a single shot in the film. The operation takes place 24 times per second.

"If we examine with a microscope the image recorded on the film, we see that it is striped with tiny horizontal lines, but these lines disappear in projection, and true third dimension appears, with the effect of shapes and things seen in the round, reproducing exactly the objects as they are seen in life."

THE "CYCLOSTEREOSCOPE"

Under the impressive name of the "Cyclostereoscope", another Frenchman, M. Savoye, has succeeded in gaining the interest of the French Cinema High Commission. It is based on the use of a ruled screen or network in the shape of a truncated cone which revolves around the screen, continually intercepting the double projected image, without breaking its continuity. The result is the perpetual reconstitution of a separate image for each eye, even if the spectator does not remain perfectly still.

The system demands, however, a technical perfection which cannot have been attained, for, in spite of its ingenuity, it has not been put into practice.

3D FOR TELEVISION

In the meantime, unspecified British technicians are credited with inventing a 3D system which is applicable to television. BBC experts are said to agree that it will work with any existing TV service and does not involve a great deal of extra expense.

A small scrambling box 18 inches square, carrying a line of six camera lenses across the front, is fixed to the camera. Spaced 2½ inches apart (average width between the human eyes), the lenses converge and focus themselves automatically as human eyes do when the camera is moved nearer the object.

A high-speed shutter opens and closes the lenses in rotation, producing, more than 100 complete frames per second. The TV camera picks up a scrambled picture thrown to a translucent screen at the back of the box, and sends the image over the air.

A special screen on the home set rearranges the picture and sends out to a wide angle for viewers thousands of pairs of parallel pictures each 2½ inches apart, and the viewer's right and left eyes receive different images, making polarised or other spectacles unnecessary.

AND FROM AMERICA

From the US comes a report of an invention by a Mr. Sanabria which "makes chorus girls in your living room come dancing right out of your set".

Here's how it's done: In Mr. Sanabria's TV studio two mirrors, simulating your eyes, pick up the image and send it to separate cameras. These cameras are synchronised to snap pictures alternately, at the rate of 15 images a second each, and the separate signals are put on the air.

When these signals are received by your TV set, the screen shows a double image, one displacing the other by about a quarter of an inch.

When you look through the slots in the viewing cylinder, another slotted cylinder whirls rapidly inside, allowing your eyes to see only one image at a time.

These things happen so fast that your eye merges them, just as they merge the separate pictures in a movie, and you perceive depth.

POPULAR SCIENCE QUIZ

Q. How are fluorocarbons used to cool certain industrial equipments?

A. These relatively new chemicals are synthetic compounds made by a new electro-chemical process which does not involve the use of the dangerous free fluorine.

One cooling application of these chemicals has been tested in power line transformers normally cooled by an oil bath. The ability of the fluorocarbons to dissipate by vaporisation about 10 times as much heat energy generated in the transformer as that dissipated by the oil bath, allows the transformer to deliver about 3.5 times as much power for the same physical size.

Instead of covering the transformer windings with the oil bath, a small quantity of liquid fluorocarbon is placed at the bottom of the tank. With the aid of a pump, the liquid is sprayed onto the windings where it is evaporated by the heat developed in the windings. Being in vapor form, the chemical circulates toward the cooling surfaces of the transformer tank where, on condensation, it gives up its latent heat of vaporisation taken from the windings. The condensed chemical falls back to the bottom of the tank. Fundamentally, the operating cycle is the same as for a refrigerant in a refrigerator.

Q. What is the deepest ocean sounding yet made?

A. To date the deepest ocean sounding is 34,400ft off the eastern coast of the Philippines. It was made in 1945 from a US Navy transport, USS Cape Johnson.

There is a huge undersea canyon in this particular area known as the Mindanao Trench and which is known to stretch for some 600 miles. It is one of a series of huge chasms which score the bed of the Pacific Ocean over great distances.

Some indications of the great depth can be gauged from the fact that Mt. Everest, the world's highest mountain, could be submerged by more than a mile. At depths of this order, about 6½ miles, there exists an entirely new world, where it is bitterly cold, silent, completely dark and where the pressure is of the order of seven tons per square inch.

Q. Why does color appear to affect our impression of size and distance, as judged by the eye?

A. Extensive studies into the matter of color dimensions has revealed that certain colors appear large or small, near or far, because the focus of the human eye is not the same for all colors.

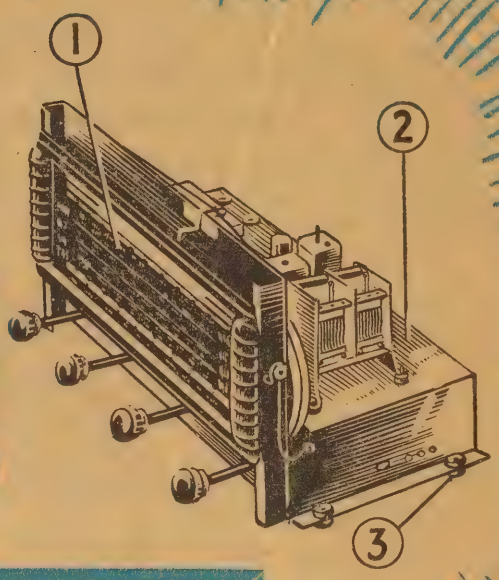
The color we call "red" focuses normally at a point behind the retina, causing the eye muscles to make the eye lens more convex and thus giving the impression that the color is nearer and larger. This is why "red" is referred to as an "advancing color".

In contrast, "blue" focuses normally at a point in front of the retina, and as the eye muscles make the eye lens less convex in order to "accommodate" the picture, the impression obtained is that the color is farther away and smaller. "Blue" is normally called a "receding" color.

SPECIAL ANNOUNCEMENT!

MAGRATHS PRESENT THE NEW 1953

DUAL-WAVE CHASSIS



If you have your own valves and speaker . . . .

THIS WILL COST YOU ONLY . . .

£16/5/-

The 1953 Dual-Wave Chassis is available for . . . .

Immediate Delivery!

LOOK AT THESE BRILLIANT FEATURES!

1. **Large, easy-to-read Slide-Rule Dial.**
2. **Circuit employs latest AVC.**
3. **Mounted on 4 shock-absorbing rubber grommets.**

As well, this CONSOLE-TYPE CHASSIS incorporates the latest Philips Innoval and has the tone-control fitted. Only the very best components are used throughout and the chassis is completely wired and ready for immediate use. Speakers are available from 30/-. Set of valves from 64/9.

JUST RIGHT FOR . . .

- YOUR BUILT-IN RADIOGRAM!
- COCKTAIL UNIT!
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IS IT WORTHWHILE?

In the meantime, Professor Chretien, another Frenchman, has completed investigations which lend support for the wide screen approach as distinct from attempts at presenting a true 3D picture.

He observed that stereoscopic vision is not possessed by all human beings. It appears that only a quarter possess it for all distances. The others only see in relief at distances of less than 40 or 50 metres. Beyond that distance their visual mechanism no longer makes the fusion of the two stereoscopic images, though this fac, is seldom realised.

The reason is that the brain makes up for this physical defect, and separates the more distant images by mental suggestion.

This phenomenon is much more frequent than is usually believed, in the perception of the external world. Inexact or even deficient sense impressions are corrected and compensated by habit.

According to M. Chretien, if we do not form for ourselves an impression of visual relief when our eyes do not supply it from the projections of the cinema, it is because the latter are too limited; in other words the photographic field is not wide enough. In a more panoramic projection, suggestion becomes effective and creates the illusion of relief.

Therefore it was not worth the trouble to create the physical conditions for visual relief as all the inventors have tried to do; it was simply necessary to place the spectator in such conditions that the impression of relief would create itself. Chretien's "hypergonar", doubles the angle of vision, thus requiring projection on to a screen 20 metres wide.

★ ★ ★

Machine psychiatry

A MICROPHONE and a sound-recorder help speed psychiatric interviewing and even psycho-analysis, according to Dr. Walter Toman, of Harvard University, who has developed a new method.

He says the apparatus records not only what a person says, but the pauses as he talks.

When the record is played back, the patient can often tell why he paused and what he was thinking of as he paused.

In psycho-analysis, Dr. Toman says the basic rule is for a patient to say everything that comes into his mind.

Whenever he pauses, the psycho-analyst may prod him.

Prodding has two risks.

The patient may be diverted from the trend of re-association, or of saying whatever comes into his mind.

The patient may be glad of the interruption if it gives him a chance to avoid talking about what was in his mind when he paused.

To test the possibility of learning more quickly what goes on in the mind during a pause, Dr. Toman had 35 men and women, aged 18 to 34, speak their life histories into a microphone.

The record was then played back, and at each pause the machine was stopped and the subject asked to tell what was in his mind during the pause.

About half the thoughts were emotion-laden memories of early life.

The rest were recent memories or thoughts about the test.

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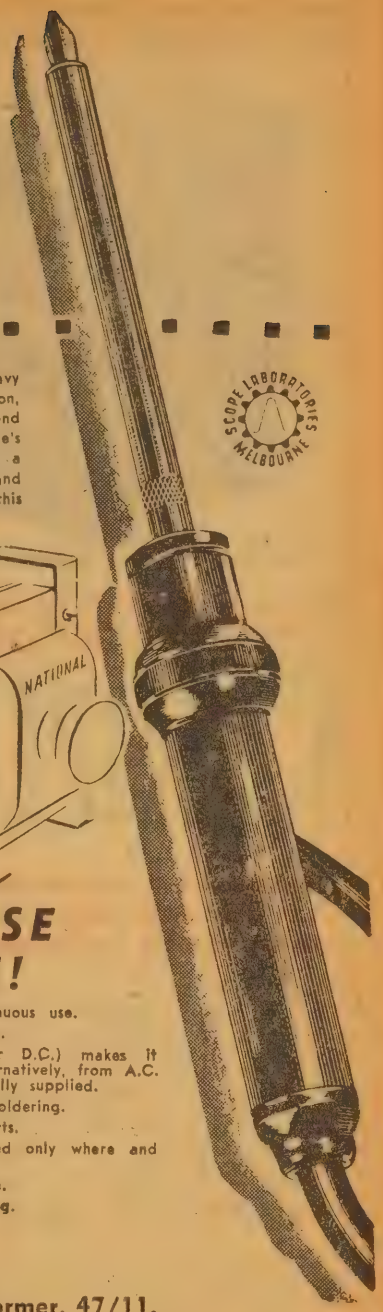

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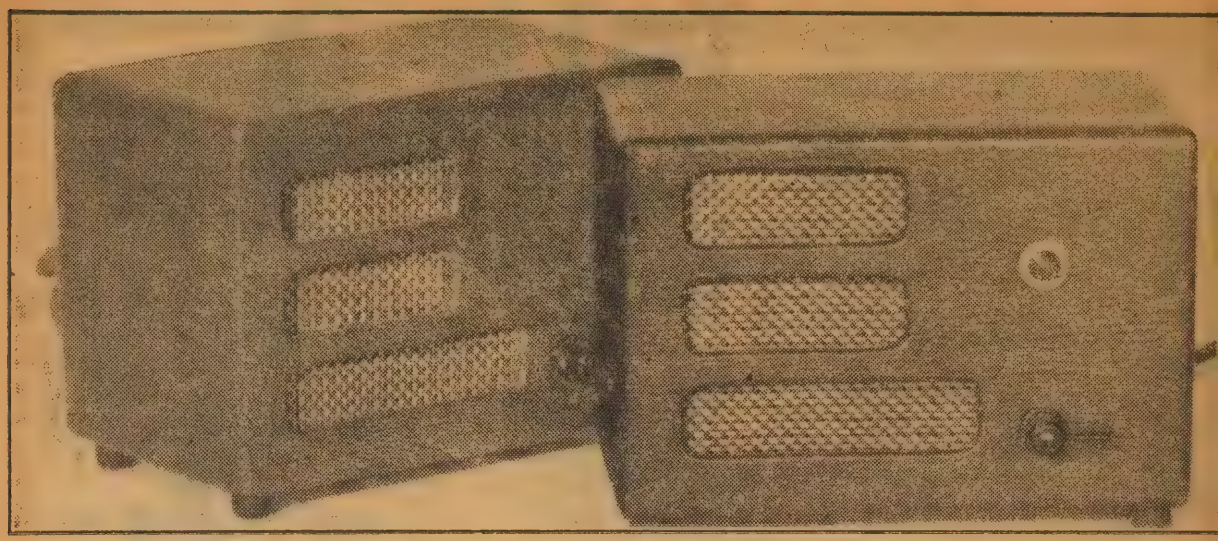


The two units which comprise the complete system. The unit on the right is the base station and the one on the left is the slave. Although housed in the same size cabinet as the base there is no reason why a smaller cabinet should not be used if this is desired. Only units to be housed are the speaker and press-to-talk switch.

A SIMPLE 2-UNIT INTERCOM.

There are many approaches to the design of an intercommunication system or "intercom", as they are usually called, ranging from complex multi-station systems to a simple two station system suitable for the home or small office. It is the latter type which we describe here.

IN May, 1949, we described an intercom system capable of operating up to 12 stations and which contained a number of unique features. One of these was battery operation from a common supply which, in turn, made possible a complete amplifier at each station. This allows any number of conversations to be conducted at the one time and is a distinct advantage over common amplifier systems which can only handle one conversation at a time.

A system based on this design was installed in the offices of our parent company and has stood the test of time in providing quick and reliable communication between the various departments involved in the production of a daily newspaper. Probably a more exacting requirement would be difficult to find.

SIMPLE REQUIREMENT

However, there are many cases where a system as elaborate as this is not justified and where the main requirement is simply to provide communication between two points. When nothing more than this is ever likely to be required, a completely different approach is justified and a very good case can be made for a single amplifier and a simple press-to-talk switching system.

Many such applications will suggest themselves to the reader but a few of the more obvious ones are worth mentioning. The small office often requires nothing more elaborate, and it will also save much time and many steps if installed between the counter and service department of a radio shop or similar organisation dealing in repairs.

In restaurants and hotels, the dining-room is frequently on a floor above the kitchen and a simple system of this kind will avoid a lot of awkward shouting down the "dumb waiter" shaft.

by Philip Watson

Nor is its value confined to commercial organisations. Used in the home it can save many unnecessary steps for the housewife. With slight modification to the switching it can be used as a "baby minder" to permit the housewife to go about her household chores and still be able to hear the slightest whimper from the nursery.

In time of sickness it will prove invaluable. In the normal way a person confined to bed can only summon assistance by ringing a bell, either mechanical or electric, which means that someone has then to walk to the sick room (sometimes on a second storey), to find out what is needed, probably return to the starting point to obtain it and then walk back to the sick room. A few bouts of this during the day is enough to fray the temper of the most patient person.

LIFE MADE EASIER

By providing actual verbal communication between the sick room and the living quarters the whole situation is changed. The patient may ask for whatever he or she requires without causing any undue hardship, particularly where they merely desire to indicate that they would like something brought them "—the next time you're coming this way". Thus a single trip can serve to provide all immediate requirements which might otherwise require several trips.

With these thoughts in mind we set out to design an AC-operated intercom which would consist of a base station and a remote station both sufficiently compact to suit an office desk, and which could be quickly and easily installed by simply plugging the base station into the mains and connecting it to the remote station by means of a length of power flex.

It was also regarded as essential that calls could be originated from either station with the same ease and without the need for any additional signal circuits, while providing complete privacy at both stations. For domestic use the unit should be capable of being modified to provide continuous communication

in one direction, with the added facility of being able to reverse the direction by means of a single press-to-talk switch.

Reference to the circuit will give some idea of how this was achieved. A relatively simple AC-operated amplifier is provided at the base station and is connected to the remote station by means of a three-wire cable. At the remote station the only equipment required is a speaker and a press-to-talk switch.

COMPLETE PRIVACY

When the system is at rest, both speakers are connected to the output of the amplifier and complete privacy is provided at both stations. When the press-to-talk switch is operated at either station, that station's speaker is transferred to the input of the amplifier and operates as a microphone. Thus, to call the other station, it is only necessary to operate the press-to-talk switch and ask for the person required.

For domestic operation the modifications shown in the second diagram are suggested. In this case the extra set of contacts on the base station press-to-talk switch are used to control the connections to the remote station, which now requires a speaker only. In the normal position the speaker at the base station is connected to the output of the amplifier and operates as a speaker. The speaker at the remote station is connected to the input of the amplifier and acts as a microphone. Under these conditions the base station is able to listen continuously to the remote station.

When the press-to-talk switch at the base station is operated the connections to both speakers are reversed; the one at the base becomes a microphone and the remote one a speaker. The base station may now speak to the remote station. For this method of operation only a two-wire cable need be run to the remote station and twin plastic flex would be ideal.

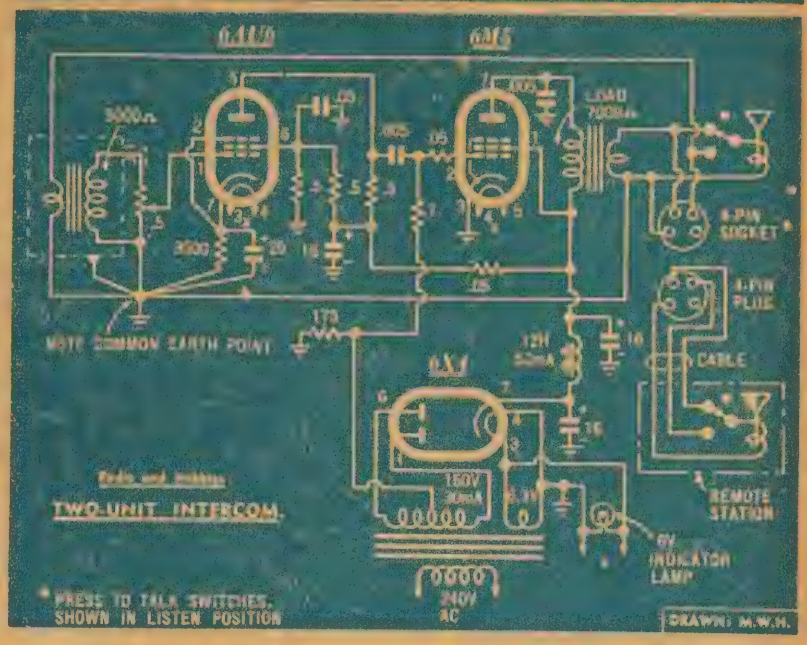
EITHER CONNECTION

If desired, there is no reason why the base station cannot be wired permanently for both systems of operation. The only modification required is to connect the two outside contacts on the unused section of the switch to the contacts directly opposite on the other section, and to take a lead from the centre contact of the unused section to the remaining unused pin on the speaker socket.

The mode of operation of the base station is now governed by the connections made to the speaker socket and it will function automatically either as an office unit (press-to-talk at both ends with complete privacy) or a domestic unit (press-to-talk at the base only and continuous observation of the remote station) depending on the type of remote station connected to it.

The amplifier is a fairly straight forward affair using a 6AU6 as an amplifier and a 6M5 as an output valve. The rectifier is a 6X4 and the power transformer is one of the 150-volt, 30 mA variety. Such an amplifier, although working below the maximum power output available from the output valve, is still capable of delivering all the power that a 5in speaker can handle without discomfort and there is little point in making it any larger.

CIRCUIT OF 2-UNIT INTERCOM.



The circuit of the complete system including the remote station. Note the common earth point which should be observed in the final wiring. Otherwise the amplifier is straight forward, the main point of interest being the audio switching system.

The main problems in an amplifier of this type are hum and instability and both are due to the same cause, namely, the need to mount the input transformer on the same small chassis as the power transformer, output transformer, and speaker. Magnetic coupling between the input transformer and the power transformer leads to hum, while similar coupling to the output transformer and the speaker voice coil causes instability.

The ideal solution to the problem is to use a transformer specially designed for such work and having balanced windings and heavy magnetic shielding. Such transformers are normally used for regular microphone circuits and the best are extremely well shielded and virtually immune from hum pick-up even in very low-level circuits.

Mu-metal is the material usually employed as a shield and as many as three shields, one inside the other, are frequently used when complete shielding is required. Unfortunately mu-metal is expensive, resulting in an expensive transformer which is only justified when the signal level is very low. Where ordinary speakers are used as microphones, the level is much higher and a lesser degree of magnetic shielding will usually be sufficient.

One method of providing such a moderate degree of shielding is to enclose the transformer (ideally with balanced windings) in a fairly heavy cast iron "pot", finally reducing the hum to a minimum by careful selection of the mounting position and angle.

Unfortunately there do not appear to be many transformers available at the present time which possess these requirements, at least at a

PARTS LIST

1 Chassis 7½in x 4in x 1¾in (Improved Intercom Amp. May 1949)
2 Cabinets to suit above
1 Power transformer 150V 30 mA 6.3V 1.7A
1 Filter choke 12 henry, 50 mA
2 5in speakers
2 Small speaker transformers (type "F" or similar) 1, 5000 ohm, 1, 7000 ohm

VALVES

1 6AU6, 1 6M5, 1 6X4

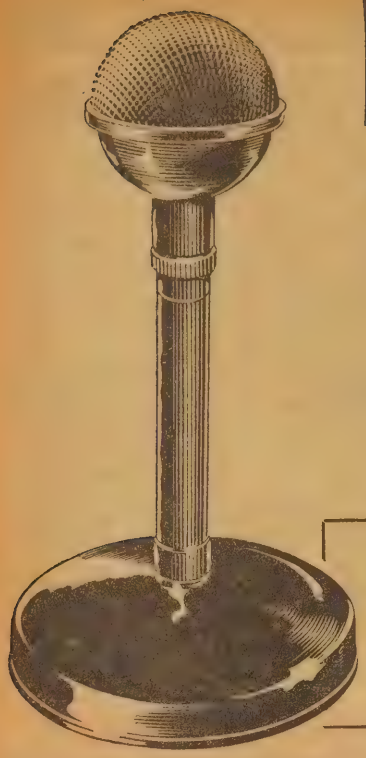
RESISTORS

1 1 meg. ½W, 3 .5 meg. 1W, 1 .5 meg. potentiometer, 1 .05 meg. 1W, 1 .05 meg. ½W, 1 3500 ohm 1W, 1 175 ohm 1W

CAPACITORS

1 25 mfd 40PV midget electrolytic, 3 16 mfd 350V electrolytics, 1 .05 mfd 400V paper, 2 .005 mfd 600V paper.
2 wafer switches 2 pole, 2 position. (Series 20, type 22, spring return.)
1 miniature 4 pin speaker plug and socket
1 miniature 7 pin socket
1 " 7 " " with shield
1 " 9 " "
1 8 terminal tag strip
1 3 " " "
1 2 " " "
2 trailer type knobs
3-core flex (as required)
2 grommets
1 6 volt dial lamp and socket
1 1¼in iron pipe coupling
Hookup wire, solder lugs, nuts and bolts, &c.

"ACOS" CRYSTAL MICROPHONES



MICROPHONE TYPE MIC 22

Mic 22 is available in 2 types.
Mic 22/2 being complete with desk stand as illustrated.
Mic 22/1 consists of the microphone with nickel plated stem at the end of which is fitted a screwed adaptor which will fit British or American type standard floor stands.
Mic 22/1 can also be used as an effective hand microphone.

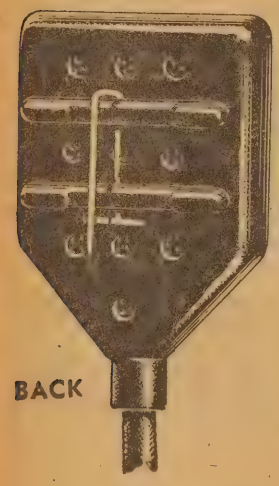
MIC 22
PRICE
£9/18/6

SPECIFICATION

Output impedance ..... Equivalent to approximately .002 MFD. (.8 megohm at 100 cycles)
Omni-directional.
Frequency response . . . Substantially flat from 40 to 6,000 cps.
Recommended load resistance Not less than 5 megohms
Output level . . Minus 50 db below 1 bolt/bar.

MIC 28 LAPEL MICROPHONE

Impedance 100,000 ohms at 1,000 cps.
Capacity .0015 mfd at 24 deg. C.
Output level approximately .55db. Ref. 1 volt/dyne/cm2.
Recommended load resistance not less than 5 megohms.
This small non-directional microphone has been designed to allow freedom of movement for public speakers or broadcasters. The dimensions of the MIC 28 are 1 9-16in. wide by 2¼in long by 5-8in thick. It is housed in a soft moulded rubber case which gives added protection against shock. The microphone hooks on to the lapel of a suit or coat. A 6' cable is supplied The MIC 28 has a level frequency response throughout the whole of the audible frequency spectrum, and consequently gives excellent fidelity of reproduction.



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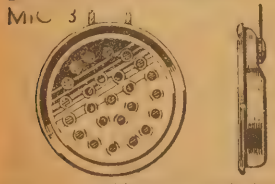
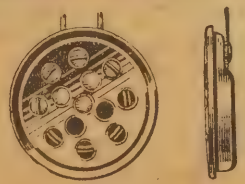
MIKE INSERTS

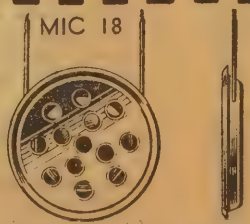


MIC 3 Diaphragm actuated Crystal Microphone specially designed for the reproduction of speech frequencies With rising response from 1000 c/s, this microphone has exceptional sensitivity. Price 39/3.



MIC 14

MIC 14. Standard Speech Microphone itself, with nickel plate brass case, which gives high corrosion resistance, mechanical strength and rigidity Price, 39/3

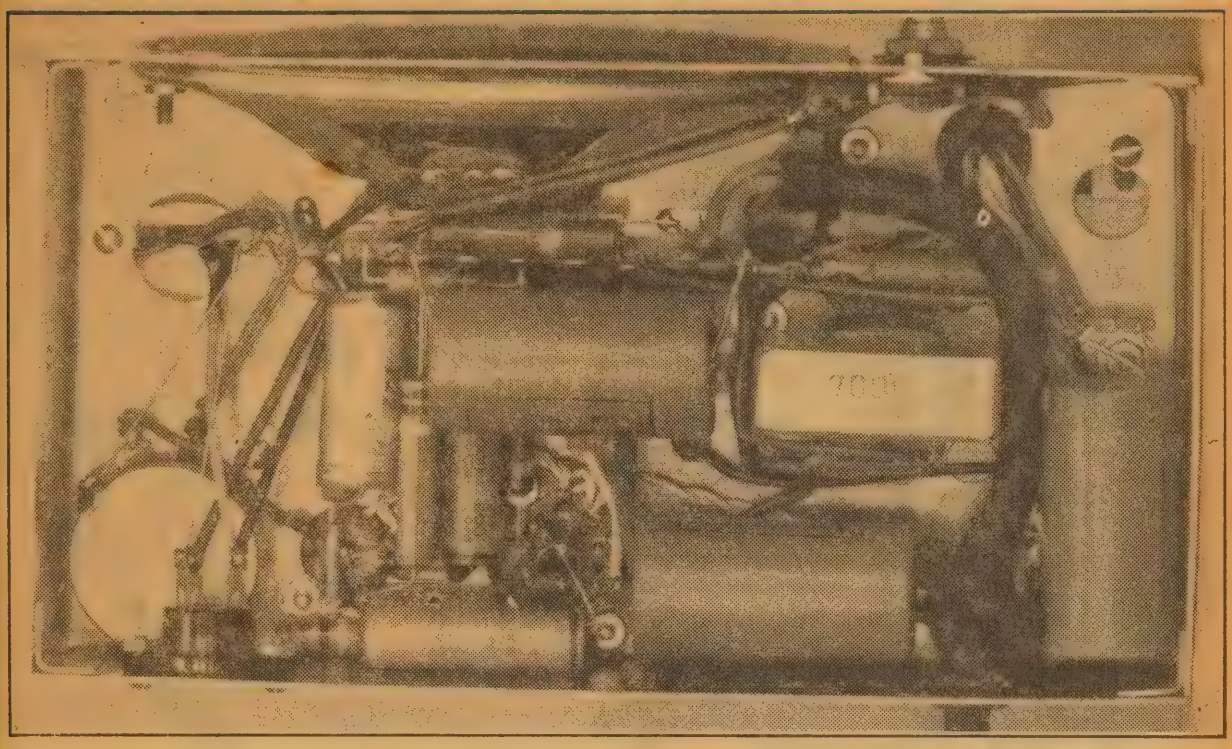


MIC 18

MIC 18. Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this insert is recommended Price, 39/6

MIC 32. Sintercel fulfils the requirements for a flat insert with good sensitivity and a frequency response 30-7000 c/s. Unaffected by vibration, exceptionally robust construction. Price, £2/15/6.

UNDERNEATH VIEW OF THE INTERCOM. CHASSIS



This underneath shot gives an excellent idea of the layout. Bottom left is the volume control and the speaker plug connecting to the remote station. To the right are the 6AU6 and 6M5 sockets in that order. Centre is the decoupling electrolytic and to the right the output transformer.

reasonable price, and we decided to see if something could be made from readily available materials.

For the transformer itself we chose a standard speaker transformer having a 5000 ohm winding and wound on one of the smallest cores normally used. It is known as a type F and is 1¾in high, 1 1-16in wide, and 2 1-16in between mounting centres. The dimensions are only critical inasmuch as they affect the method of shielding. The impedance of 5000 ohms may appear rather lower than usual for an input transformer but it provided adequate gain and there is some doubt whether any additional gain could be used.

HEAVY SHIELD

To make a pot for the transformer we purchased an iron pipe coupling from a plumbers' supply house. It is marked 1¼in which means, by some queer reasoning in the plumbing industry, that the internal diameter is 1¼in and the external diameter 2in. It is 2in long.

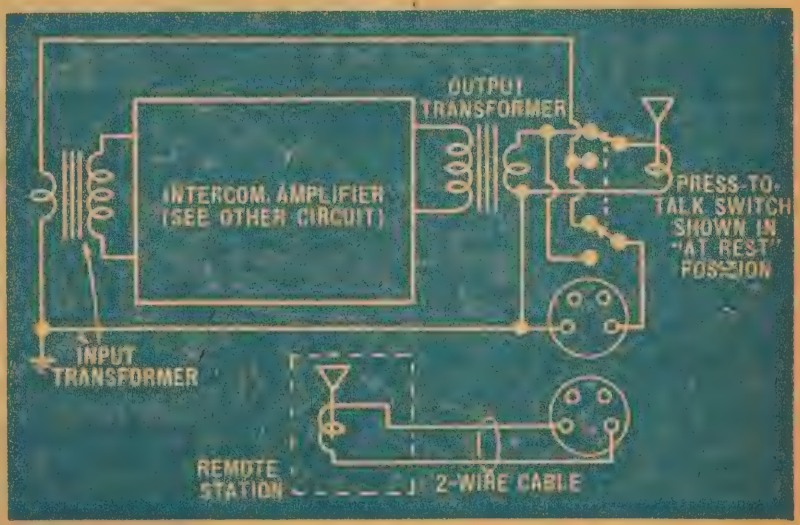
(The 1¼in actually refers to the internal diameter of the pipe for which the coupling is intended.)

The ¼in walls of this coupling make quite an effective shield and there is ample room to house the type F transformer. The only modification required is to remove the mounting lugs from the transformer which would otherwise be too long. To hold the transformer firmly in the shield we cut a small wooden packing piece which is a force fit between the top of the transformer and the inside wall of the shield, the transformer being mounted "on end".

The transformer should be mounted tight enough to prevent it moving but should still be capable of being rotated within the shield. This allows it to be set to the position of minimum hum pickup without the need to rotate the shield. To finish things off we cut a disc of aluminium for a cover and fastened this in place with two 1-8in screws, corresponding holes being tapped in the end of the shield. Two holes were tapped in the other end of the shield to permit it to be mounted on the chassis.

Coupling between the input and output transformer is not serious with the layout chosen, but there was definite evidence of coupling between the speaker voice coil and the input transformer.

This caused serious instability

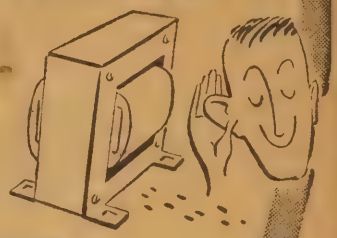


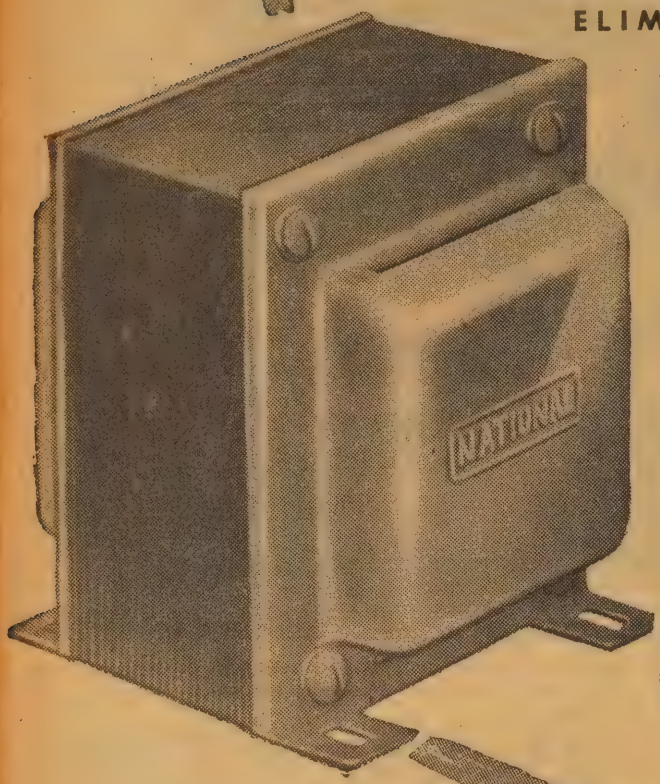
Circuit showing the modified switching arrangement recommended for domestic use. By combining the above wiring with the original circuit the base unit will need no further modification, functioning automatically for either system when the appropriate remote station is plugged in.

THEY'RE QUIET . . .

LAMINATION HUM COMPLETELY ELIMINATED

This has been achieved in types up to 50mA's by sturdy one-piece clamps of which the mounting brackets are an integral part; and in the larger transformers by using metal covers and a one-piece clamp, both of heavy section to ensure absence of fatigue.





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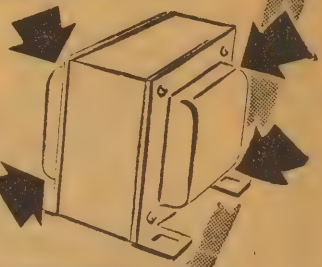
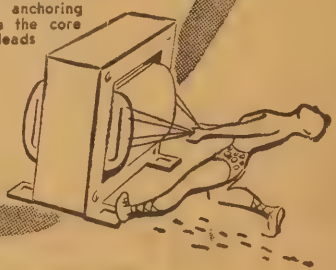


THEY'RE TOUGH

These quality transformers are constructed on sound, robust lines. A special feature of this is the exclusive anchoring method used inside the core to prevent the leads being pulled out.



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when the gain was advanced to a reasonable level and, even when it was below this point, would give rise to a brief burst of oscillation as the remote station switch moved from the "listen" to "talk" positions. It was cured by the simple procedure of reversing the connections to the speaker voice coil, any coupling then providing negative rather than positive feedback.

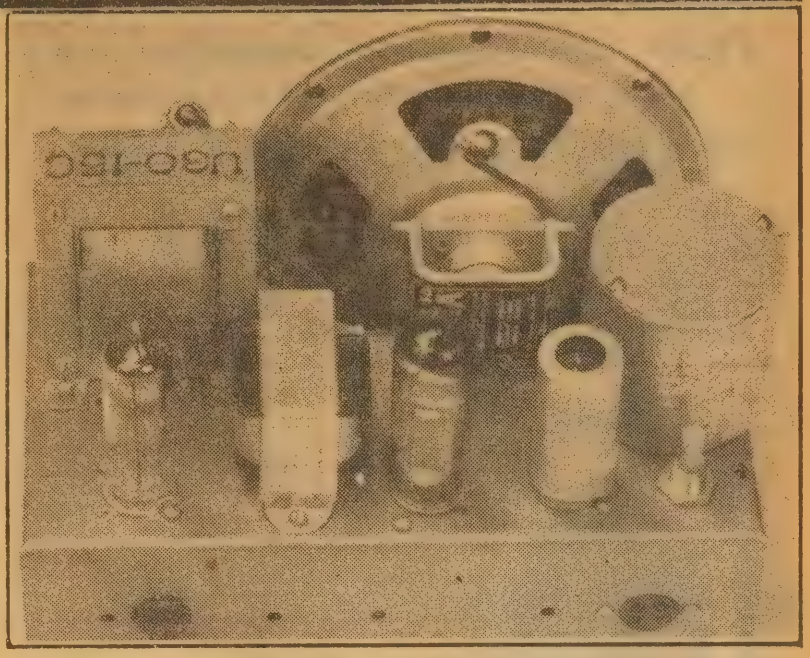
Also in the interest of stability it is desirable to bring to a common earth point all the connections shown on the circuit as being so terminated. At the relatively low impedance of the voice coil circuits it is quite easy to provide unwanted coupling due to the resistance of the chassis or even a common connecting wire, thus giving rise to instability. In its final form the amplifier was completely stable even at full gain.

DECOUPLING

As well as hum and instability due to transformer coupling, there is also the risk of these troubles occurring within the amplifier itself and the final design must take precautions to avoid them. The power supply is generously filtered with two 16 mfd electrolytics and a small 12 henry choke. In addition, the plate and screen supply for the 6AU6 is decoupled with a .05 megohm resistor and another 16 mfd electrolytic.

The only shielded lead required in the system is that from the input transformer secondary to the volume control. Since this lead is part of the transformer, we found the easiest method of shielding was to strip the shielding braid from a length of shielded wire and slip it over the existing wire. All the other audio leads are low impedance and thus do not require shielding.

POSITION OF MAJOR COMPONENTS



A top rear view showing the major components. Extreme right is the input transformer in its "pot". Near it is the 6AU6 valve, then the 6M5, with the 6X4 front left. The power choke is between the last two valves.

The 6M5 was rendered quite stable, without any tendency to supersonic oscillation, by means of the .05 megohm stopper resistor in the grid circuit and the .005 mfd capacitor from plate to chassis. This latter component also assists in balancing the reproduction for maximum intelligibility.

The chassis used for the original

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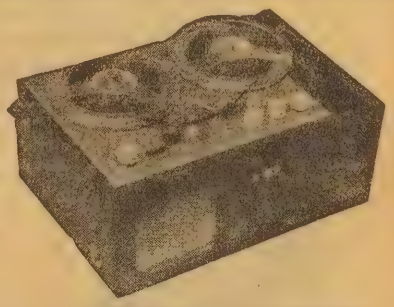

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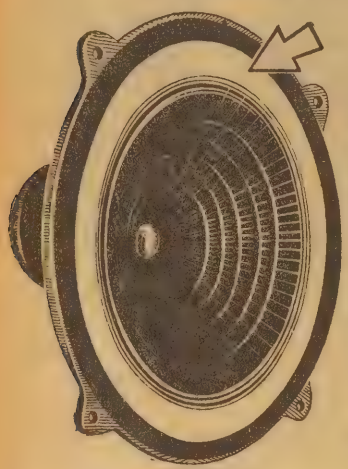

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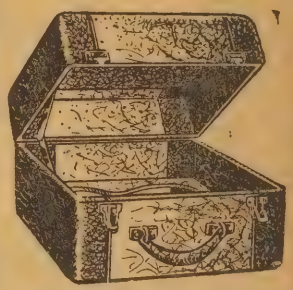

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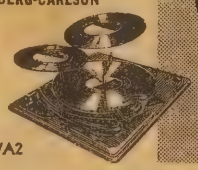

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1949 battery intercom proved to be admirably suitable for this unit also, thus simplifying the supply problem and also making possible the use of the same cabinet. For the most part, the existing holes fitted in to the new design quite well, though a few extra ones had to be cut. Three of these are large ones, one being for the miniature speaker socket, one for the power cord, and one to bring the power transformer leads to the underside of the chassis. The remainder are only 1-8in mounting holes.

We hope to prepared a modified blueprint showing the extra holes in order that the chassis manufacturers will be able to supply either type. However, in the meantime, it may be necessary to use chassis cut to the original blueprint. In most cases no great difficulty should be experienced in cutting the extra holes.

5in speakers appear to be the most suitable size for units of this kind, being a good compromise between small size and reasonable efficiency. The 3in types, while attractive from the angle of compactness, are much lower in efficiency than the 5in types, both as speakers and microphones. In some cases a larger speaker at a remote station may help to overcome a high noise level, when working as a speaker, though they are sometimes inclined to be boomy when used as a microphone.

The construction does not present any serious problems and an excellent idea of the layout can be obtained from the photographs. Used in conjunction with a ready-made chassis they should provide all the information necessary to enable the original to be duplicated.

SMALL COMPONENTS

However, there are a few points regarding the selection of components which are worth mentioning. The 25 mfd., 40-volt electrolytic capacitor should be of the new midget variety, while the 16 mfd., 350-volt electrolytics should also be the smallest obtainable. The ones we used were 15/16in diameter by 1¾in long and anything appreciably larger than this should be avoided.

The output transformer should be similar to the input transformer already discussed, such as a type "F". It is likely that most isocore type transformers would be too large. The smaller paper capacitors should also be selected to make for easier wiring though it is possible that the larger types could be accommodated without too much alteration to the layout. All the resistors are one watt types except the 6M5 grid resistor and grid stopping resistor.

Above the chassis the only component likely to cause trouble is the speaker. The type we used has a very small magnet housing and there is plenty of room for it.

Some types, however, have much larger magnet housings and are likely to be difficult to accommodate without considerable alteration to the layout. If the longer dimension is placed in the horizontal plane there may not be enough room for the input transformer unless the volume control is moved. If placed in a vertical plane the speaker will be too high to fit in the standard cabinet.

To assist in mounting the minor components an eight terminal tag strip is mounted along the front of the chassis near the speaker cut out. This serves to terminate the 6AU6

(Continued on Page 104)

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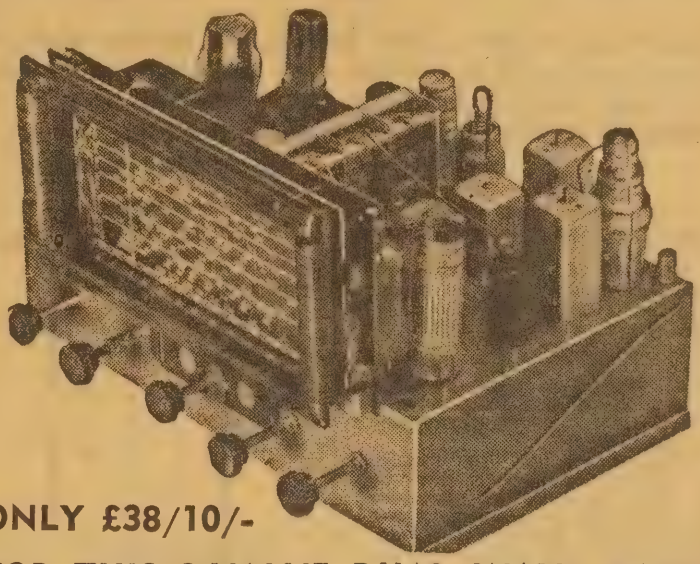

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Here's your answer, Tom!

These radio engineers, Tom, belong to a peculiar class of people who are never content. Having put a grid in a diode valve to make a triode they decided that they had better put in a couple more grids so that they could have tetrodes and pentodes. Maybe there is some worthwhile justification for their fun and games. At any rate, if you read this article, you can decide for yourself.

THE triode valve, which we talked about last month, made possible a tremendous advance in the art of radio communication. The extremely weak signal received by the aerial could, after detection by a diode, be amplified by a triode and applied to a pair of headphones.

If one triode amplifier was not sufficient, two stages could be used. Three amplifying stages and a loudspeaker became a practical proposition in many cases.

As we pointed out last month, Tom, the real advantage is that the actual energy to drive the reproducing device comes from the batteries. The signal from the aerial merely acts to control the current in the valve.

When a bus driver pushes the brake pedal to stop the bus he applies only a few pounds pressure and yet the force stopping the bus may be many thousands of pounds. In a rough analogy, the brake pedal is the equivalent of the grid of the valve and the wheels of the bus the equivalent of the plate circuit.

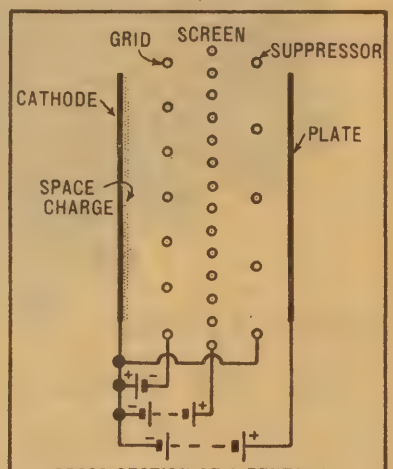
INFINITE AMPLIFICATION

Unfortunately, Tom, you can't keep on adding amplifier stages to amplify weaker and weaker signals to speaker level. With very high degrees of amplification great care is necessary to prevent some of the signal from the output circuit straying back into the input circuit. If this happens, a progressively larger signal builds up and the amplifier finally generates impulses of its own with complete disregard for the signal from the detector. In technical language, it is said to OSCILLATE.

By careful design, very high degrees of amplification can be obtained with an audio amplifier. Separate power supplies can be used for different stages to prevent coupling through the power supply and shields can be installed to prevent electric and magnetic coupling between input and output circuits.

Unfortunately, as soon as you have solved this set of problems you find yourself faced with another. It's rather like putting a tight motor-car tyre on the rim, Tom. You no sooner get it on in one place than it comes off in another!

The electrons do not travel from cathode to plate in a smooth, steady stream, but tend to go in little bursts. With very high degrees of amplification the irregularities in the electron flow of the first valve appear in the output as hiss or noise.



An enlarged cross section of a typical pentode valve. It can give much greater amplification than a triode and is suitable for radio frequencies. The load is placed in the plate circuit.

If the noise is stronger than the signal you will hear more noise than signal in the output and, after all, Tom, it is the signal, not the noise, that you are interested in.

As if this kind of noise isn't sufficient of a problem, slight mechanical vibrations that wouldn't be noticed in a medium gain amplifier move the electrodes of the valve relative to each other and cause ringing noises in the output. For extremely high-gain amplifiers, valves with very rigid electrode structure are designed.

RADIO FREQUENCIES

If, however, the set uses an amplifier stage operating on the radio frequency signal before it is applied to the detector many of the problems are overcome. The amplifier is then designed so that it accepts only signals from the aerial: signals from the loudspeaker or headphone circuit have no effect if they happen to stray into it.

Noise due to the irregularities in the electron flow can only get through the amplifier if it happens to be of the frequency at which the amplifier is designed to operate. As it happens, the noise is distributed over a wide range of frequencies and only a small part of it can get through.

The same argument applies to the noise generated by vibration. If bumped, the electrodes of the valve invariably vibrate at a very much lower frequency than the signal, so that, when the amplifier is tuned, the corresponding variations in output are not passed on.

SELECTIVITY

You see, Tom, the radio frequency amplifier can be made to select a narrow band of frequencies and amplify them in preference to all others. An audio amplifier placed after the detector could also be made selective but it would only be useful for listening to Morse code signals all with the one note. Voice and music cover a wide range of frequencies in the audio spectrum and to sound natural the audio amplifier must amplify them all by the same amount.

But the signal impressed on the radio frequency carrier wave only causes it to spread from its nominal frequency by a small amount so that a selective amplifier can be used.

Although a triode valve of the type we have already discussed can be used as an amplifier at radio frequencies, there are some serious disadvantages.

The signal applied to the grid appears amplified at the plate, but, as well as passing on to the load in the plate circuit, some of the signal appears back at the grid circuit via the capacitance existing between the plate and grid.

The amount of signal fed back to the grid circuit depends on the frequency at which the amplifier is operating as well as the capacitance between the plate and grid. It increases as the capacitance increases and it also increases as the frequency increases.

Without going into the subject too

Tetrodes and Pentodes

eply, it isn't practical to construct triode valve which will give good rformance at the frequency of the gnal and at the same time have a fficiently low plate to grid capaci-nce to prevent oscillation. There are special circuits which utralise this capacitance in order prevent oscillation. The difficulty that they require critical adjust-ent and are therefore only of use an amplifier which operates on a ngle frequency. The amplifiers in dio transmitters are often neutral-ed, but, in most cases, a receiver required to tune over a range of equencies which makes successful utralisation very difficult.

The solution to the problem is to troduce another electrode into the lve. This electrode is similar to e control grid, but is wound around e outside of the control grid be-ween it and the plate. Effectively, screens the grid from the plate d therefore goes by the name of REEN GRID or just SCREEN.

LECTRIC SHIELD

With the screen grid in place, the pacitance between the grid and ate is split up into two, one be-ween plate and screen and the other tween screen and grid. The screen n be effectively earthed as far as dio frequencies are concerned by nnecting a comparatively large ndenser between it and earth.

In order for it to be effective as a ield, the turns of the screen grid ust be wound fairly close together. his being the case, the electric harge on the plate has very little ffect on electrons in the space harge near the cathode and, for a rrent to flow, the screen must be ade positive. Fortunately, it can e made positive and still retain its reening properties.

When the screen is charged posi-vely with respect to cathode it be-aves something like the plate of a iode and electrons in the space harge around the cathode are ttracted by it, subject, as before, to ne effect of the control grid. As it pproaches the screen, the stream of ectrons has a considerable speed.

A few of the electrons hit the reen and cause a current to flow in ne screen battery circuit, but most ave acquired such a high velocity hat they pass through between the reen wires where they come under ne influence of the plate, which is sually even more positive than the reen. Therefore, the plate current considerably greater than the reen current.

CREEN GRID VALVE

At the same time the screen volt-ge has a greater effect on the plate rrent which flows because it is sponsible for setting the electrons motion in the first place.

As you will see from the valve rves of a TETRODE, or four ele-ent valve, provided the screen oltage is fixed, the plate voltage an be varied over a wide range ithout much change in plate cur-ent.

The control grid still has the same ntrol effect on the electron stream with the triode, but the only mmunication that the grid has ith the plate is via the stream of gh speed electrons.

The tetrode can therefore be used a radio frequency amplifier with-

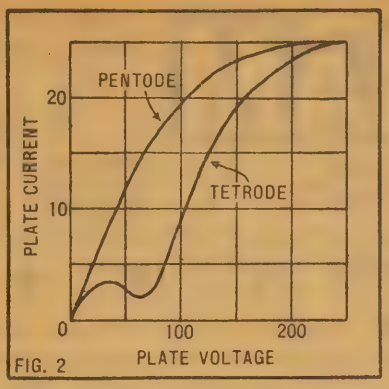


FIG. 2

These curves illustrate the relation between plate voltage and plate current for tetrode and pentode valves. Note the peculiar fault in the tetrode curve. At certain plate voltages it gives a decrease in plate current for an increase in plate voltage.

out the undesirable effects that occur with a triode. Actually, with careful design to prevent feedback occurring via paths outside the valve itself, two or three radio frequency amplifier stages can be used ahead of the detector valve without trouble with oscillation.

One or more tuned circuits can be used with each valve so that the selectivity of the receiver is improved as well as the gain.

The tetrode valve does have a particular disadvantage which so far we have not mentioned. Some of the high speed electrons striking the plate cause other electrons to be dislodged from the plate. You will remember we mentioned this phenomenon, or secondary emission as it is called, in the June issue.

Actually the same thing happens in a triode valve, but here the secondary electrons are repelled back to the plate by the negative grid and the secondary electrons do not cause any unwanted effects.

However, in the tetrode some of these electrons are attracted by the screen and cause a high screen current to flow at the expense of the plate current. With many tetrodes, if the plate voltage happens to be of the same order as the screen voltage, an increase in plate voltage will actually reduce the plate current.

The effect can be overcome by inserting yet another grid, called the SUPPRESSOR, between the screen and plate. It is usually connected to the cathode and thus has a nega-

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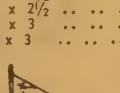
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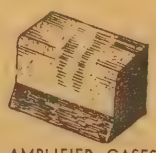
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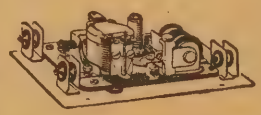

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ive charge. Secondary electrons released from the plate are repelled by the suppressor grid and return to the plate.

Their velocity on returning to the plate is small compared with velocity of the electrons which first hit the plate and caused the secondary emission so that the undesirable effect is not repeated.

For best results, the suppressor grid is wound with a very open spiral. It then has little effect on the electrons making their way from the cathode to the plate, but has a large effect on the slowly moving secondary electrons.

Other methods of overcoming secondary emission effects are sometimes used. Valves are sometimes made with the control and screen grids aligned so that electrons form into beams in their passage cathode to plate.

The beam is further concentrated consists of a resistor with a continuously variable tap. The signal is applied across the full resistance element and the signal to be passed on to the next stage tapped off as required.

However, the overload frequently occurs in amplifiers operating at radio frequency and in this case it is not always so easy to control the amplification.

The problem can be solved by a special VARIABLE MU valve. (Mu is the symbol for amplification.) Instead of winding the grid in an even spiral the turns near the centre are spaced further apart than those near the ends. If the grid bias on the valve is increased a point will be reached where electrons are no longer able to flow through the grid turns near the ends but are still able to flow through the centre. In this case the degree of amplification given by the valve will be less.

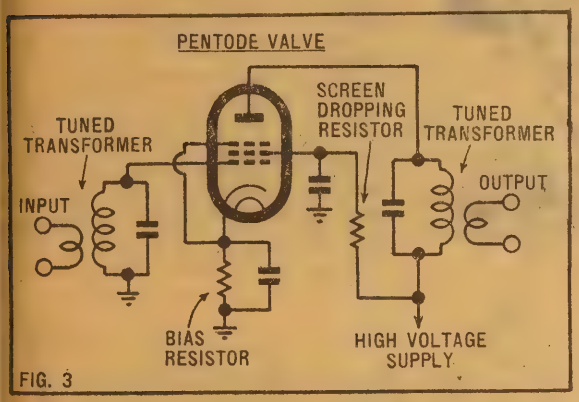

FIG. 3

A practical pentode radio frequency amplifier stage using a pair of tuned transformers. The screen supply is obtained from the same source as the plate but through a dropping resistor. This avoids the need for a separate supply.

by a pair of plates which are connected to the cathode and fit around the outside of the screen support wires. This special form of construction overcomes the effects of the secondary emission without the need for a suppressor grid and at the same time results is higher efficiency and sensitivity. It is often used in power output valves for receivers and amplifiers and transmitting valves.

Ordinary tetrode valves were used as amplifiers in receivers of a couple of decades ago, but either beam tetrodes or pentodes are used these days because of their much improved performance. We merely mention the tetrode to complete the story.

But don't run away with the idea, Tom, that triodes are superseded by pentodes. There are plenty of applications where the special characteristics of pentodes are of no particular value. Look through the circuits in various issues of Radio and Hobbies and note how often triodes are used.

AUTOMATIC VOLUME CONTROL

A special problem arises with a large receiver having several RF and AF amplifier stages. The full amplification of the receiver is needed to receive weak and distant stations but this gain is merely an embarrassment on the local stations. The amplification can easily be so high that some of the later valves in the receiver will be called upon to handle a stronger signal than they are capable of.

It is fairly easy to instal a control in the audio section of a receiver to reduce the gain to the required value. An ordinary volume control

With a variable-mu valve, therefore, it is possible to alter the effective amplification of the valve by altering the steady bias applied to the grid. With some valves the amplification can be varied from a ratio of 100:1 down to 1:1 simply by applying greater negative bias.

Most modern receivers have a diode rectifier which rectifies some of the signal voltage after it has passed through several amplifying stages. The rectifier is connected so that a negative bias is developed. This bias is then filtered and applied to the grids of the RF amplifier valves.

AVC RECTIFIER

Thus, if a strong signal is tuned in, a large bias is developed and the gain of the receiver is reduced. Again if a weak signal is tuned in, the bias is reduced automatically and the full gain of the receiver is available.

This system is usually called automatic volume control or AVC and you will find few large sets which do not include it. Besides adjusting the gain to take care of weak and strong stations, it helps keep distant fading stations at a constant volume as heard in the speaker.

Well, Tom, once again we have given you quite a deal to think about. That valve data book we mentioned last month should come in especially useful this month to look up the various types mentioned. If your book has a section containing typical circuits look for triodes and pentodes and see if you can work out the function performed by the valves. We will continue the story next month.

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Let's Buy An Argument

At the risk of creating an international incident, I am constrained to raise the question as to whether overseas designers are really so much more clever and resourceful than local engineers. One would think from some of the overseas literature that they were.

by W. N. Williams

LET me hasten to point out, right at the beginning, that I am thinking on a plane that is familiar to us all — radio sets, amplifiers, test instruments, and so on. When it comes to radar, guided missiles, atom-bombs and such-like, it's rather difficult to discover who's doing what.

Actually, what set me thinking along these lines was some literature I received from the United States, suggesting that the reader might like to spend some of his hard-earned cash on crystal set components. Maybe I, as the reader, hadn't stopped to consider what the humble crystal set could do.

REAL SELECTIVITY!

I learned from the literature that a certain new type of crystal detector would give me "100 pc selectivity", able to spot a station on a single point of a 100-division calibrated dial.

Another type of crystal set would work a loudspeaker 24 hours a day, if need be. It would wake me in the morning with pleasant music, thereby eliminating the need for an alarm clock.

If neither of these features appealed to me, I could build a short-wave crystal set and listen to the amateurs, the police, to aeroplane chatter, fire calls and so on. Was there not a verified contact to prove it of some 3000 miles?

Then I remembered a letter from someone in Singapore, I think it was, who had allegedly made an ordinary catswhisker crystal to oscillate. Why bother with valves and batteries when you can have a regenerative crystal set?

It's high time we fellows in Radio and Hobbies woke up to ourselve from the editor down — not to me tion all the other engineers in Au tralia, who will insist on using valv for every set they design.

I wonder?

Parrot fashion, we simply repe the old formula . . . "about 15 mil range, earphones only".

Do overseas designers know mo about crystal sets than we do? A better parts available? Or are the simply more "on the ball"?

I'd say that the answer to all thre questions is a definite "No".

AUSTRALIANS ALSO

We, too, have had reports fro readers who have managed to l an interstate station on a crystal se Only last week, we were talking someone else who enjoys loud speaker reception in his bedroo from a crystal set — in fact, he ha done so for the past 15 years.

Short waves? Well, that might b possible, too.

But a few loudspeaking crystal set a few DX reports, a few short-wav stations don't mean a new era, an more than a few traditional swallow mean a summer, or whatever it is.

The fact of the matter is that th AVERAGE crystal set doesn't d these things, and I don't care whe ther the locale is Sydney, Schened tady, Sourabaya or Soho.

If you're very lucky with the loca tion and placement of the aerial, yo may get DX, loud signals or short waves. If you're very unlucky, yo won't get anything. Most likely you'll just turn out to be anothe owner of an "Average" crystal set.

I'd almost forgotten the other grou who like to make crystal sets in ear pieces, matchboxes and even pencil that let you "listen while you write" Reading about these things, one i often left to infer that they perform just like the full-sized variety.

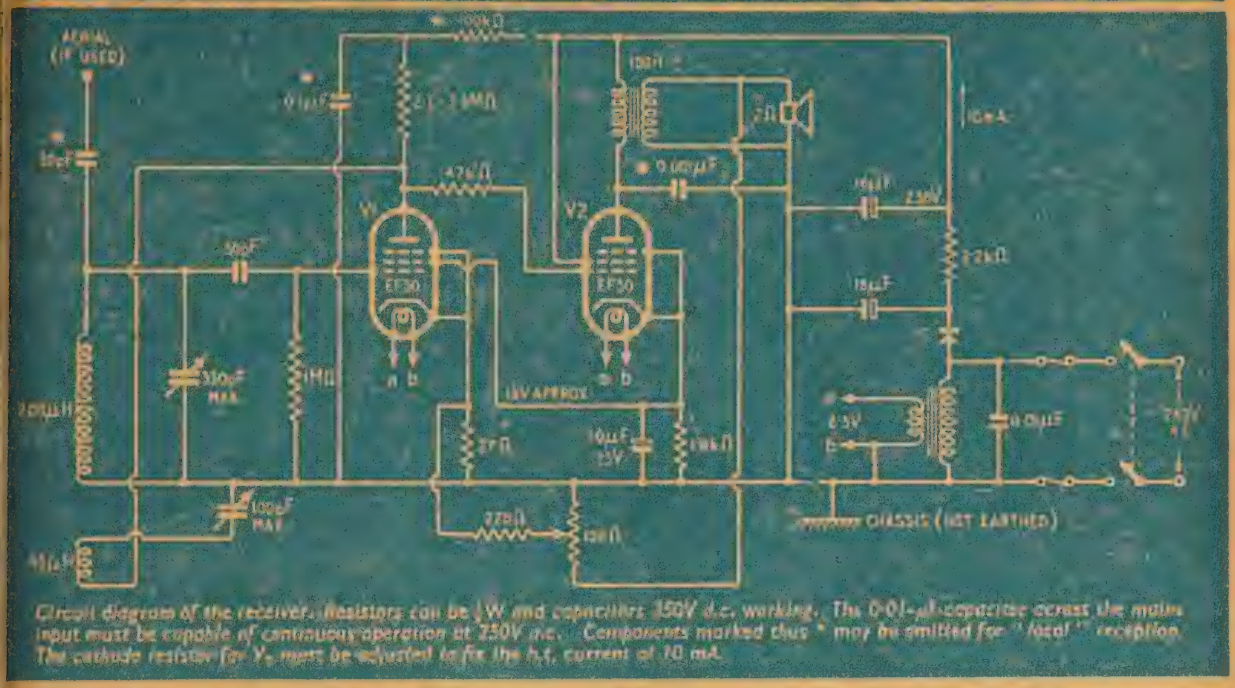
THEY JUST WORK

Phooey! To hear anything at al is an accomplishment. If you ca tell what the man's saying . . . that' great. If you can tune more than single station, that's wonderful.

The point of the matter is tha there isn't any substitute for a high-Q coil and an effective, properly coupled aerial and earth.

If you're keen on crystal sets, b all means build them as small a you can, as simple as you can, a efficient as you can; try them o loudspeakers, tune them on the short waves — anything you like, bu don't fret yourself to an early grave

TYPICAL SMALL SET DESIGNS FROM OVERSEAS



Circuit diagram of the receiver. Resistors can be ½W and capacitors 350V d.c. working. The 0·01-μF capacitor across the mains input must be capable of continuous operation at 250V a.c. Components marked thus * may be omitted for "local" reception. The cathode resistor for V_2 must be adjusted to fix the h.t. current at 10 mA.

An interesting two-valve design from the May 1953 issue of Wireless World. If you have any ideas of building it, play safe and use a miniature power transformer to isolate the high tension circuit from the power mains.

because you can't get a decent circuit, or parts like they have overseas.

They haven't any substantially better parts, or better circuits. They can't build them neater or more efficient than you can.

What they do have is more powerful stations and that gives them a start. But even that advantage will diminish soon when local stations begin putting up their power.

Still, I wonder how good you could make a crystal set? What say you didn't care about the size of the coils or the complexity of tuning? Be fun to try, wouldn't it?

SMALL SETS

Of course, this small set business can be quite intriguing. How well I remember my own efforts as a youth in the country with parts borrowed from my father and grandfather before me and run-down batteries "scrounged" from someone who could afford to replace them.

There was that priceless reflex set, with a couple of old battery triodes and a crystal detector. You could pull in the city station quite clearly on the loudspeaker, too — provided everyone maintained a deathly (and courteous) silence.

Much more recently, I have enthused over little sets like the "Reflex Two" and the "New Minivox". Two valves and a rectifier, yet they brought in the locals with any amount of volume for the home. I can't imagine that any one of the European circuits that one sees from time to time could have done much better.

We duly described them, but did they "go over"? Well, some readers said they liked reading about small sets, some said they built them, but there wasn't any riot. They never looked like challenging the popularity of the "Little General" type of thing with that important extra valve.

We've seen commercial sets of like design and the same story has been repeated. The little sets might have been cute, interesting, cheap or something, but they were treated like toys rather than real radios. What's the answer?

(1) Can't we design simple sets in Australia?

(2) Won't Australian experimenters and listeners be bothered with trivial things?

(3) Are Australians too off-handed to enjoy the pleasure of accomplishment?

Just by way of illustration, we show on this page a couple of small set designs which came literally from the first two magazines I pulled out of the pile on my desk.

The first is one from our esteemed contemporary Wireless World, and is credited to one H. E. Styles, B Sc.

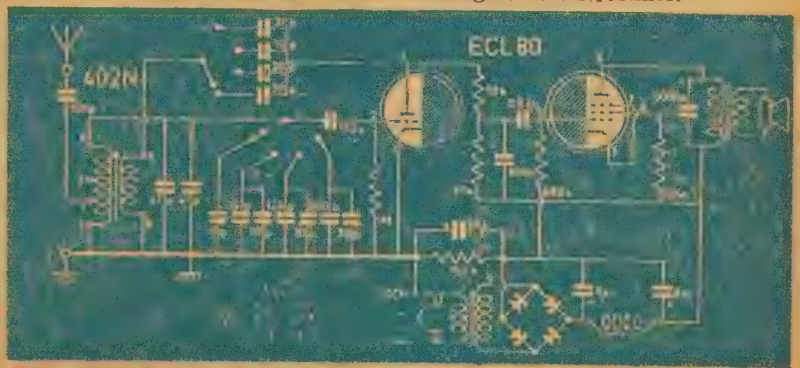
The basic design rather appealed to me when I first saw it. Ostensibly, the detector is an ordinary Reinartz type of thing but the designer has selected conditions which allow it to operate into a very high value of plate load. As a result, the stage gain is abnormally high.

DIRECT COUPLED

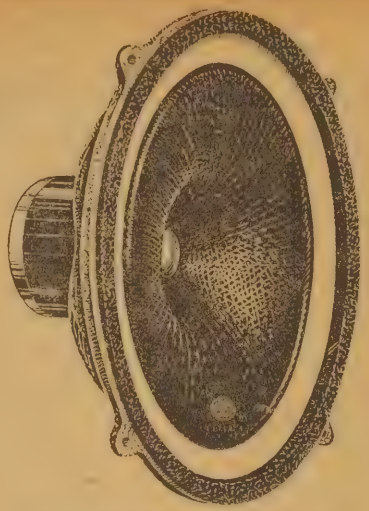
The general arrangement makes it possible to couple the detector plate directly to the output valve grid, the detector screen deriving its potential from the output valve's cathode.

The receiver has a negative feedback circuit and, for all that, can allegedly still turn on a good performance from a very short aerial.

That much of the circuit is quite interesting but the power supply arrangement sends chills down my spine. As far as the high tension circuit is concerned, it dispenses with the regular power transformer and taps the AC mains directly through a metal rectifier.



Preset switched tuning is the special feature of this little set featured in a Dutch magazine. Otherwise the circuit is conventional, with all the familiar limitations of a two-stage design.



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That involves a direct connection etween the mains and the receiver hassis and the whole thing becomes potential death trap for the unary experimenter. I want to say ore about this aspect a little later.

The other circuit comes from a utch magazine and uses a valve hich has been available here for me time, either as an ECL80 or the AB8.

The designer also goes for a ansformerless high tension supply, sing a bridge rectifier — and my rmer remarks apply!

The rest of the circuit is just an rdinary regenerative detector plus utput which would be little differnt from other sets having the same umber of stage stages. The novelty ngle is in the switch-tuned arangement, which employs preset rimmers for both tuning and rection, instead of the usual gang ondenser.

LOUDSPEAKER RECEPTION

In both cases the assumption is hat listening will be done on a oudspeaker — a fact that tends o impress itself on the reader far ore than any possible qualifications hereto. The circuit might likewise e credited with a mysterious but ompletely unjustified degree of electivity.

Of course, reception conditions verseas do not necessarily duplicate ocal conditions and a design that is minently satisfactory in one place s not necessarily so in another.

There are stations in America far ore powerful than any in Australia nd, under equivalent conditions, ome of them must be received at roportionately greater strength than ve could hope for here. That much s in their favor.

Then again, in Europe, the disances involved in most countries are horter than in Australia and the hoice of stations is limited too by olitical and language barriers. Facors like these must influence final erdict and there are doubtless many eaders far more qualified to discuss heir significance than "yours truly".

However, the point I am trying to nake is that, although these little ets may be interesting enough, they ren't radically different in their perormance from designs that the averge Australian doesn't take seriously.

This would seem to be an excellent alibi for the many Australian deigns, whose imagination appears to e limited to a four valve superhet with various types of dial attached.

POWER SUPPLIES

Coming back to the question of ransformerless power supplies, they do have an obvious appeal to the nake-it-cheaper-and-smaller exponents. You see them frequently in American mags. in connection with eceivers, transmitters, phono-oscillators — in fact almost any electronic gadget you can think of. One I remember well was a gramo. amplifier for the nursery.

The valve heaters are strung in series and operated through a device called a "line-cord resistor". One side of the mains is connected to the chassis, the other passes through a rectifier and filter system to the HT line.

It saves parts and weight and, thanks to the 110-volt power mains, the risk of serious shock isn't very great. An inadvertent contact with a live chassis in an "earthed situation" might register only as "a bit of a shock".

But what a difference there is when you jack the mains voltage up to 240! The "bit of a shock" becomes almost certainly lethal and supply authorities very rightfully frown on transformerless equipment of any description. They rightfully demand protective cabinet work and interlocking switches which make it impossble for straying non-technical fingers to get in contact with the metalwork.

Nor is the risk limited to the non-technical types. I've designed and/or built many commercial AC-DC receivers and muttered silent prayers as they passed out through the door.

I've seen hardened factory testers insulate themselves on a wooden stool before they'd start testing them.

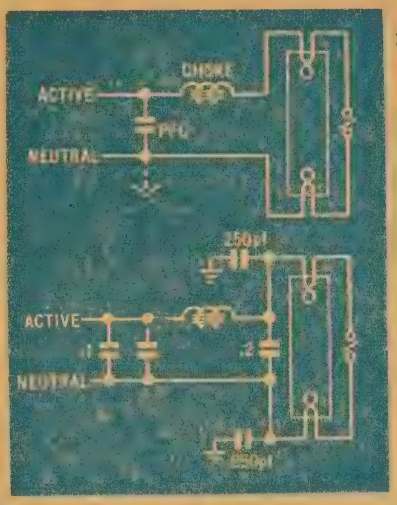
I freely admit to not liking transformerless designs and being a party to the idea of not encouraging their construction by home builders. After all there's enough sorrow in the world as it is!

"Which all goes to show," you may retort, "how short-sighted are our electrical engineers as well". Fancy electing to supply our homes with mains which are patently so lethal.

That may be true but the matter doesn't end there. For example, there's the small matter of line loss, which must send American supply authorities grey or whatever color worried Americans go.

The kind of load which would make our lights "a bit dull" would make theirs a sickly yellow. And the kind of load that makes ours "sickly yellow", well . . . I leave it to you and our erstwhile friend Georg Simon Ohm!

Fluorescent Light Noise



Dear Sir,

I have read with interest the letter from L.J.D. on the subject of interference from fluorescent lighting units. I have also read the original "Answer to Correspondents" which caused the trouble.

My experience of this trouble is both extensive and varied but, on the whole, I am inclined to agree with the view expressed by your good selves.

I too have found that only rarely does a fluorescent unit cause serious trouble and that, if one does, it is usually traceable to a particular tube (individual specimens of which can be noisy) or to faulty components and/or connections.

And please L.J.D., do not think that I am in an area served by many powerful stations. Here in Penola, SA, our nearest station is 5SE in Mount Gambier, only 1000 watts and 32 miles away. 3WV Horsham, Victoria, is over 100 miles away and is our best station but otherwise we have to "drag them in" all the way from Adelaide, Melbourne and Sydney and places in between.

Actually, at the moment I am listening to a program from 2WG Wagga, NSW, on a 1945 "Advance" without the faintest trace of interference although I am in a building adjoining the local power house and my brother is working in the next room (the office of the Penola Electricity Supply) by the light of a Twin 20 watt fluorescent unit.

There are numerous fluorescent units both in private houses and on business premises here but the local complaint is not insufficient stations but too many stations too far away. Fading is quite a serious matter and it is impossible to separate a number of stations as they are on a similar wavelength. However, that is another story.

My method of dealing with a fluorescent unit is first to check on its polarity. All that I have seen have one black wire and one of another color, sometimes white sometimes red or brown. This black wire should always be connected to the NEUTRAL wire of the supply mains.

A glance at the accompanying diagram will show that the choke (ballast) and P.F. correction condenser form a filter between the tube and the mains — and, as the neutral of the supply is usually earthed at the meter board, any hash developed in the tube is bypassed to ground.

On the rare occasions that this and other obvious points did not reduce the interference to a negligible quantity, earthing the metal frome work of the unit had the desired effect.

Finally I am enclosing a copy of a circuit which was given to me by the Superintendent of Wireless in this State, for the suppression of particularly recalcitrant fluorescent units. I have never found such drastic measures necessary, but the information may be of use to others not so fortunate.

Yours faithfully,
A.G.M.

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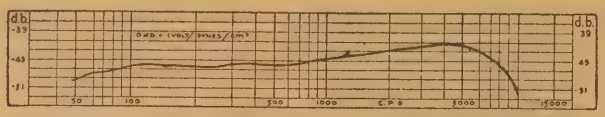

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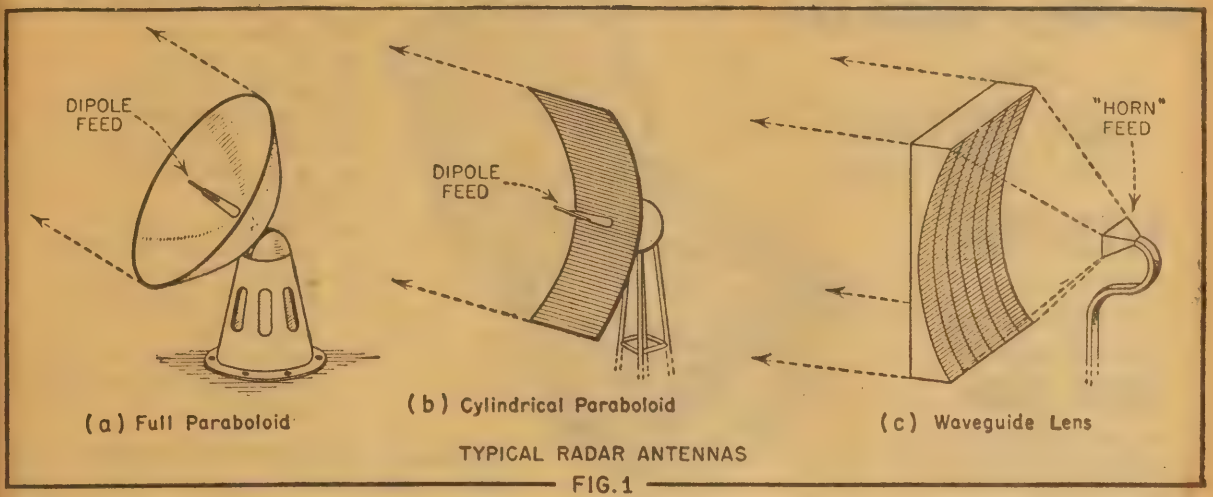


TYPICAL RADAR ANTENNAS

FIG. 1

This is the concluding issue in the series of articles by Aerovox engineers dealing with the fundamentals of the basic radar system. It is concerned with the radar antenna system and the electronic switching means employed to enable the same antenna and transmission line to be shared between the radar transmitter and receiver.

"DUPLEXING", as this function is called, is common only to radar practice and has its only counterpart in the "antenna changeover" switch of communications radio. The other specialised components of the typical radar system were discussed in preceding issues.

Becaue of the very short wavelengths used in modern radar (about 1 to 25 centimetres), the antennas employed are capable of very high figures of gain. This high gain is a useful by-product of the high directivity required to obtain accuracy in determining the postion of a radar target.

In order that the azimuth and elevation of a target be indicated with precision, the width of the antenna pattern must be small.

Therefore, if the total energy radiated by the antenna is concentrated in a narrow cone, the radiated signal strength on the axis of that cone will be hundreds of times greater at a given point in space than if an omni-directional antenna were used.

The gain of a highly directional antenna, such as the paraboloid, as a function of its aperture area in square wavelengths, is given by:

(1)
$$G = \frac{8A}{\lambda^2}$$

Where:

G is the power gain of the antenna.
A is the antenna aperture (cm^2).
λ is the operating wavelength (cm).

From this it may be seen that the gain for a given area is inversely proportional to the operating wavelength squared. Thus an antenna of a given area will have 100 times more gain at 1 centimetre than it has at 10 centimetres.

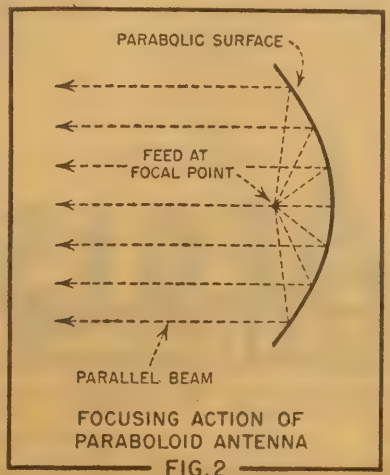
For this reason, antenna gain is relied upon to compensate for the lower RF power available at the shorter wavelengths used for modern radar.

Fig. 1 depicts several basic forms of microwave antennas commonly employed for radio detection and ranging.

Of these, the paraboloid (Fig. 1a) has been used the most extensively to date. In this design, a parabolic reflector made of sheet metal, perforated metal, or screen is illuminated uniformly over its surface by RF energy radiated from a source at the focal point. This source, usually called a "feed", may be a small dipole or a waveguide horn.

NARROW BEAM

The divergent radiation from this source is focused by reflection from the parabolic surface into a nearly parallel ray like that of a searchlight. See Fig. 2. Beamwidths as narrow as half degree at the half power points are produced in this manner. The theoretical beamwidth is related to the wavelength and diameter of the parabola as:



FOCUSING ACTION OF PARABOLOID ANTENNA

FIG. 2

(2)
$$\theta = 70\frac{\lambda}{D}$$

Where:

θ is the half-power beamwidth in degrees.
λ is the operating wavelength (cms)
D is the diameter of the parabola (cms).

In some applications, it is necessary to produce a radar antenna having a radiation pattern which is narrow in elevation but wide in agimuth, or vice versa. This is usually accomplished by the use of a cylindrical parabola, or a "cut" parabola, as shown in Fig. 1b.

Unlike the complete paraboloid, this antenna is highly directional in one plane only, i.e., the plane of its greater aperture dimension. By "shaping", or using various sections of a full paraboloid, the pattern in both the vertical and horizontal planes can be controlled to fit any given application.

WAVEGUIDE LENS

Equation 2 may be used to predict the approximate beam-width in either plane by using the diameter of the parabola in that plane.

A third general type of antenna, which is finding increasing microwave radar application, as well as widespread use in microwave radio relay systems, is the waveguide lens type illustrated in Fig 1c.

This design makes use of the fact that a mosaic of waveguides of different lengths can act as a lens to focus radio waves in a manner similar to the focusing of light waves by a glass optical lens.

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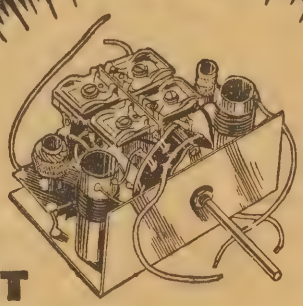

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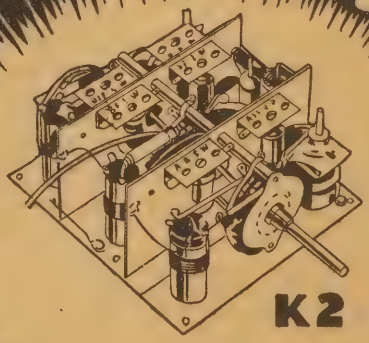

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This comes about because the radio frequency waves travel at a different velocity through the waveguides than they do in free space, just as light travels at a different velocity in the glass lens.

As a result, rays which enter one end of the waveguide mosaic lens may be converged, diverged, or rendered nearly parallel, as with an optical lens.

WAVEGUIDE LENSES

An important difference, however, is that the contours for waveguide lenses are opposite those of the glass lenses which perform corresponding functions, as shown in Fig 3.

This reversal is due to the fact that radio waves travel faster in the metallic guide than in air, whereas light waves travel slower in glass than in air. Hence, the wave fronts are refracted differently by the same contour.

The same kind of "feed" systems may be employed to illuminate lens antennas as are used for parabolas. The lens antenna has several advantages over the parabola, including less wind resistance for a given aperture and the fact that the feed point is behind the antenna, rather than in front of it. This places fewer restrictions on the feed system to prevent distortion of the radiated pattern.

The gain and half-power pattern widths of a metal lens antenna are the same as those of a parabola of equal dimensions, as given by Equations (1) and (2).

SINGLE ANTENNA

Even with the most powerful transmitters and the most sensitive receivers available, the successful operation of a radar set requires the highest antenna gain and directivity possible.

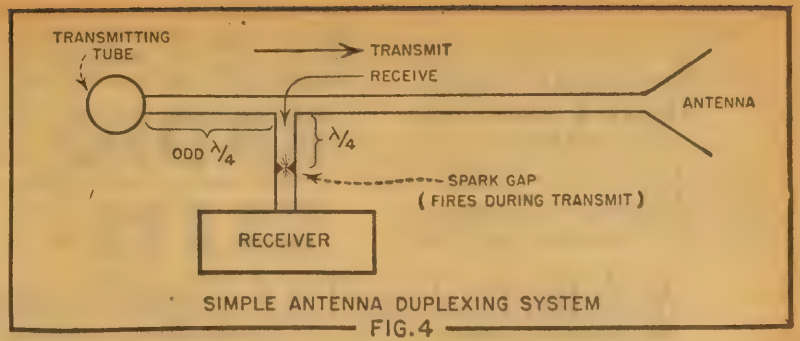
Since this, in turn, means antennas having large, physical dimensions, it is highly desirable to use the same antenna for both transmitting and receiving. In this way the gain of a single large antenna is utilised twice.

To do this, however, it is necessary to connect the antenna to the transmitter for a few millionths of a second while the pulse is sent out, and then switch it to the receiver during the "listening period" between pulses. This function is called "duplexing" and is accomplished by gas-filled devices known as "Transmit-Receive" tubes, or more simply "T-R" tubes.

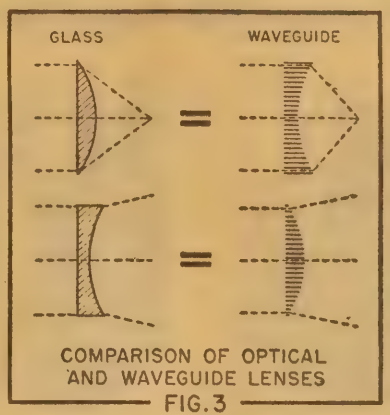
The duplexing system must prevent the very high peak power of the transmitter from damaging the sensitive crystal mixer input stage of the receiver while, at the same time, "recovering" fast enough after each pulse to enable the receiver to receive echoes from nearby targets.

The duplexing system must also make provision to prevent the weak received signals from being absorbed in the magnetron transmitting tube.

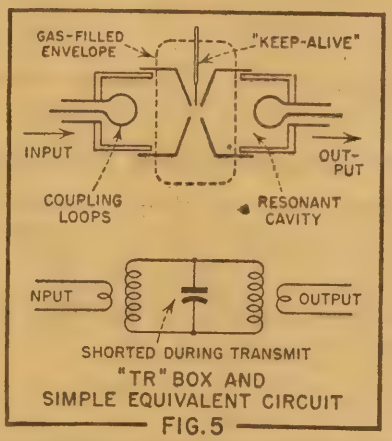
To fulfill these requirements, modern duplexing systems make use of the large power difference between the transmitted signal and the received echoes.



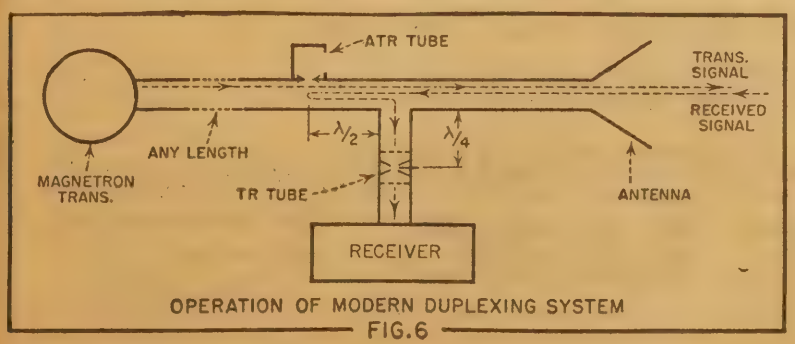
SIMPLE ANTENNA DUPLEXING SYSTEM
FIG.4



COMPARISON OF OPTICAL AND WAVEGUIDE LENSES
FIG.3



"TR" BOX AND SIMPLE EQUIVALENT CIRCUIT
FIG.5



OPERATION OF MODERN DUPLEXING SYSTEM
FIG.6

Since the transmitter power is of the order of kilowatts or megawatts, while the received signals from distant targets are more typically measured in micro-microwatts, a switching device which will discriminate between such extremes of power is used.

Fig. 4 illustrates an elementary duplexer utilising this principle. Here as spark gap is placed across the branch line leading to the receiver and set to break down at high power but remain in-operative at low power.

SPARK GAP

Since the discharge in the gap constitutes a virtual short circuit across the transmission line, very little transmitter power reaches the receiver.

If the distance from the junction point to the gap is one-quarter wavelength, the impedance of the branch line appears very high when the gap is "fired" and all of the power goes through to the antenna.

When the transmitter pulse ends, the gap is extinguished and, since any received signal is much too weak to initiate a breakdown in the spark gap, signals flow freely to the receiver.

If the length of transmission line between the receiver arm and the magnetron is properly chosen, the received signals will encounter a high impedance in travelling toward the magnetron and hence still flow mainly into the receiver.

In actual practice, the simple duplexing system of Fig. 4 is employed only with refinements. To obtain adequate crystal protection, the voltage at which the gap fires must be reduced. This is done in T-R tubes by enclosing the spark gap in an envelope which is filled with a gas, such as hydrogen, under pressure.

TIME LAG

A third electrode, known as a "keep-alive", is also introduced into the hollow cone forming half of the gap. The function of the keep-alive electrode, which is maintained at a high DC voltage with respect to the cone, is to produce a small gas discharge within the cone.

The presence of this keep-alive discharge greatly reduces the time required for the main gap to fire when the RF pulse arrives.

A third refinement consists of making the gap part of a tuned circuit which is resonant at the transmitter frequency. This increases the voltage across the gap and further reduces the time required for the tube to fire.

Figure 5 shows a typical T-R tube

(Continued on Page 51)

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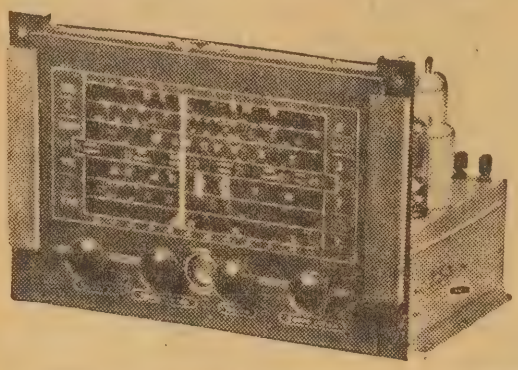

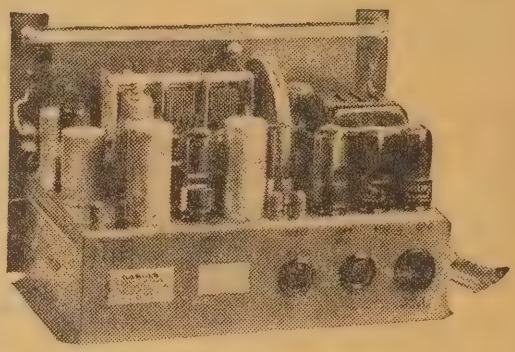

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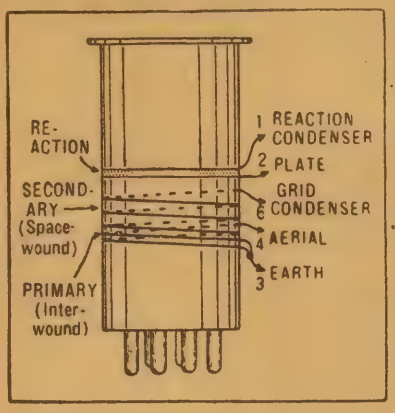
COIL DETAILS FOR SMALL RECEIVERS

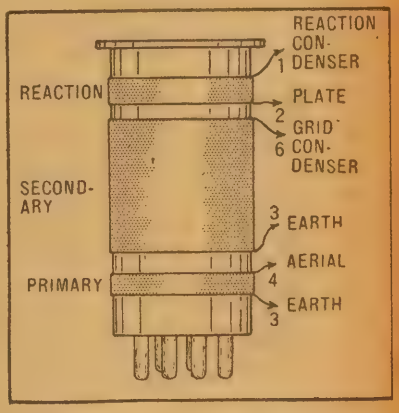
One of the most popular pamphlets available through our query service is the one under the above heading. Since there does not seem to be any slackening of interest in the small receiver, we are publishing the data again with a few amendments. A reprint of this article will still be available in pamphlet form.

DURING past years, hundreds of small sets have been described in technical magazines for home construction and there has been a wide variation in the design of appropriate tuning coils.

Before about 1930, the general tendency was to use large 2in or 3in diameter formers, wound with heavy-gauge cotton covered wire. These coils were characterised by ease of winding and adjustment, and by good efficiency, but had a tendency to produce bad hand-capacity effects.

More recent practice has been to use smaller formers and finer wire to make coils which exhibit less hand-capacity effect, and which are more convenient from the layout point of view. They are also more readily adaptable to the requirements of plug-in or switched all-band reception. Very small litz-wound and iron-cored coils have made their appearance, but these are too difficult to make at home.





The drawing at the left shows the general style of the windings for the higher frequency coils, including the interwound primary where specified. That on the right shows the lower frequency close wound arrangement.

GENERAL DATA

The accompanying data will be found suitable for nearly all small regenerative receivers, with or without an R-F stage. Formers should be of the usual 1½in diameter, either ribbed or plain.

Exact coil requirements for any individual set are affected by associated components and reception conditions generally, so that a little experimenting will often result in vastly improved performance.

Thus, if a receiver proves in practice to be too unselective, try the effect of reducing the number of turns on the primary winding and/or increasing the spacing between primary and secondary. This improves the selectivity at the expense of the gain. Increasing the number of turns and/or the coupling has the opposite effect.

With regard to the reaction winding: If the receiver fails to oscillate toward the low frequency end of the band, it may be necessary to increase the number of turns on the reaction winding and/or to move it closer to the secondary. If the reaction cannot be controlled properly, it may be necessary to remove turns and/or move the winding away from the secondary. If the reaction does not work at all, try reversing the connections to the reaction winding.

For reasonable coverage of the broadcast band, a tuning condenser with a maximum capacitance of from 350 to 400 mmfd (.0004 mfd) is required. The use of a smaller tuning condenser would necessitate additional sets of coils, or, alternatively, the switching in of a capacitance in parallel with the tuning condenser to cover the low frequency end of each band.

PARALLEL CAPACITOR

Thus, when using a .00025 mfd condenser, the high frequency portion of each band may be covered in the normal manner. To cover the low frequency portion, switch a mica condenser of .0001 or .00015 mfd, directly in parallel with the tuning condenser.

The above coil details are on the assumption that the tuning condenser has a maximum capacitance in the vicinity of 400 mmfd. The overlap is sufficient to allow for considerable variation in maximum and minimum capacitance.

All coils are wound on 1½in diameter formers, which is the most usual size for plug-in coils. For the sake of economy, only three popular SWG gauge enamelled wires are specified. Wires of slightly different gauge and/or with different insulation could be used, but due allowance would have to be made for the different space occupied by the coils and the resultant effect upon the inductance.

It is helpful to refer to wire tables, as given in the "Radiotron Designer's Handbook" and similar texts. Thus, 32 SWG gauge enamel will be found to occupy similar winding space to 29 or 30 B&S gauge enamel, or to

(Continued on Page 51)

BAND (With Trimmer)	BAND (Without Trimmer)	AERIAL PRIMARY	RF PRIMARY	SECONDARY	REACTION
1620 Kc to 550 Kc (Broadcast Band)	2 Mc to 570 Kc (Broadcast Band)	15T. 32 SWG Enam. Spaced 3/16in from earthed end of secondary	Increase to 25 turns	100T. 32 SWG Enam. Close wound.	40-60T. 40 SWG Enam. Spaced ⅛in from grid end of secondary.
79 to 256 metres 3.85 to 1.17 Mcs	64 to 255 metres 4.7 to 1.18 Mcs	11T. 32 SWG Enam Spaced ⅛in from earthed end of secondary	Increase to 15 turns	38T 25 SWG Enam Close wound	20-35T. 32 SWG Enam. Spaced ⅛in from grid end of secondary.
32 to 108 metres 9.3 to 2.8 Mcs	26.7 to 103 metres 11.2 to 2.9 Mcs	5T. 32 SWG Enam. Spaced 1/16in from earthed end of secondary	Increase to 8 turns	13T. 25 SWG Enam. Spaced to occupy ¼in	9-15T. 32 SWG Enam. Spaced ⅛in from grid end of secondary.
11 to 37 metres 27 to 8 Mcs	10 to 36.6 metres 30 to 8.2 Mcs	1T. 32 SWG Enam. Interwound from earthed end of secondary	Increase to 3 turns	4T. 25 SWG Enam. Spaced to occupy ¼in	4-6T. 32 SWG Enam. Spaced ⅛in from grid end of secondary.

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RECEIVER POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF185	240	150	30	6.3V/2A
PF299	240	285	40	6.3V/2A, 5V/2A
PF300	240	325	40	6.3V/2A, 5V/2A
PF201	240	225	50	6.3V/2A

NOTE: All transformers are available with upright mounting. The following 9 transformers are also available with flat mtg., fitted with an adaptor plate to suit 3 x 3½in centres. On removal of plate, mtg. centres become 2½ x 3 1-8in. IF flat mtg. is required afix Code No by letter F e.g. PF151F.

PF151	230, 240	285	60	6.3V/2A, 5V/2A
PF166	230, 240	325	60	6.3V/2A, 5V/2A
PF165	230, 240	385	60	6.3V/2A, 5V/2A
PF170	230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A
PF169	230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A
PF168	230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A
PF130	230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF164	230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF160	230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF152	230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A
PF163	230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF181	230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A
PF174	230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A
PF142	230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF175	230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF167	230, 240	385	150	6.3VCT/2A, 5V/3A, 2.5VCT/5A
PF173	230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A
PF140	230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A
PF171	230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A

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PF172	230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A
PF143	230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A
PF179	230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5V/3A
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A

C.R.O. TRANSFORMERS

PF188	240	350 one ext. 900	30 2	6.3V/2A, 6.3V/1A 5V tap 4V/2A 4V tap 2.5V/2A
PF545	240	350 one ext. 1000	20 1	6.3V/3A, 6.3V/.6A, 4V tap 2.5/2A

TAPE-RECORDING TRANSFORMERS

PF642	230, 240	250	80	6.3V/3A, 5V/2A Low radiation
PF664	240	265	80	6.3V/3A, 5V/2A Low radiation

PHOTOFLASH TRANSFORMERS

HT119	200	4000 ½ wave	
HT131	240	1100 ½ wave	prim. also vib. 5.2 or 4V

POWER CHOKES

CODE NO	IND HY.	DC RES.	DC MA	CODE NO.	IND HY.	DC RES.	DC MA
CF100	50	1900	10	CF112	10	70	250
CF101	30	870	25	CF113	5/20	70	50/250
CF102	15	300	60				
CF103	30	420	60	CF115	.017	.6	2A
CF104	30	580	80	CF119	.005	.1	6A
CF105	15	250	80	CF162	10	90	330
CF106	12	200	100	CF196	20	130	125
CF107	30	360	100	CF114 40 watt fluor ballast			
CF108	12	135	150	CF213 20 watt fluor ballast			
CF109	20	225	150	Fitted with rubber mounting to			
CF110	12	100	200	reduce hum. Standard 5¼in hole			
CF111	16	165	200	centres.			

VIBRATOR AND A.C. POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF182	240AC 12V1B	200	40	12.6/1A
PF122	240AC 6V1B	220	40	6.3V/2A
PF125	240AC 6V1B	250	60	6.3V/2A
PF126	240AC 12V1B	250	60	12.6VCT/1A
PF119	240AC 6V1B	325	125	6.3V/4A
PF146	200, 230, 240 AC 12V1B	325	150	12.6VCT/2.5A

VIBRATOR TRANSFORMERS

CODE NO	PRIM VOLTS	DC Volts	O'put mA	Buffer Full Sec	
VT101	6	90	15	.008	
VT102	6	150	25	.005	
VT103	6	200	50	.005	
VT127	6	200	50	.005	Low radiation. Car Radios
VT104	6	250	60	.005	
VT107	6	250	60	.005	Low radiation. Car Radios
VT106	6	300	75	.008	
VT122	6	400	50	.005	
VT146	12 or 6	240AC	50w	1MFD	For Emergency light, etc.
VT112	12	200	50	.005	
VT132	12	200	60	.005	Low radiation. Car Radios
VT105	12	250	60	.005	
VT117	12	250	60	.005	Low radiation. Car Radios
VT114	12	300	75	.008	
VT123	12	320	125	.005	
VT113	24	200	50	.005	
VT116	24	250	60	.005	
VT115	24	300	75	.008	
VT119	32	150	25	.005	
VT100	32	200	40	.005	
VT124	32	250	60	.005	

FILAMENT TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF118	220, 240, 260	2.5V/5A, 2.5V/5A
PF158	220, 240, 260	5V/8A
PF476	240	6.3V/3A
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A
PF162	240	6.3V/3A, 6.3V/3A
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A 5V/3A, 2.5V/7A
PF102	240	7.5V/2A
PF111	240	10V/5A
PF211	200, 230, 240	10VCT/10A
PF131	230, 240	10VCT/10A, 5V/15A
PF123	240	15, 12, 8, 6V/1.8A
PF439	240	32V 60W Enclosed one outlet
PF457	240	32V 125W Enclosed two outlets
PF491	240	32V 200 W Enclosed two outlets

BATTERY-CHARGING TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF265	230, 240	17V tap 11.5, 10, 8.5/4.2A
PF389	230, 240	17, 11.5, 10, 8.5V/4.2A, 17, 11.5V/4.2A 17, 11.5V/4.2A
PF537	240	17V tap 11.5V/0.4A

BELL TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF648	240	10W Continuous or 2A intermittent.

Fully enclosed including 240V socket and outlet terminals. Designed to operate local and imported chimes as well as various types of bells.

IN ADDITION TO THE ABOVE RANGE, A STANDARD RANGE OF OUTPUT AND MODULATION TRANSFORMERS IS AVAILABLE

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SURVEY OF RADAR TECHNIQUES

(Continued from Page 47).

in its resonant cavity and a simple lumped-constant equivalent circuit. The T-R box acts as a band pass filter when the gap is not ionised during receiving, and the signal is attenuated only 1 db in passing from one coupling loop to the other.

When high power ionises the gas, however, the band-pass properties of the cavity resonator are destroyed since the effect is the same as short circuiting the capacitance in the equivalent circuit.

Under these conditions the attenuation is about 60 db and very little power is coupled from one loop to the other.

The important properties of the T-R switch are the ionisation time, the leakage power which reaches the receiver through the fired device, and the recovery time necessary to allow the gas to deionise so that signals can reach the receiver. These properties are controlled by varying the T-R gas filling and water vapor content, the cavity "Q", the keep-alive voltage, &c.

As was mentioned above, provisions must be made in a duplexing system to insure that a large portion of the received signal is not lost in the transmitting tube which terminates the line from the antenna.

In early duplexing systems, use was made of the fact that the non-oscillating magnetron tube does not match the line impedance very closely, so that most of the power is reflected. The T-R junction was then placed at a point on the transmission line where the impedance toward the magnetron was high.

This system worked but placed undue restrictions on the position of the T-R junction and the "cold" impedance of the magnetron. It has been replaced in most cases by the use of a device known as an "anti T-R" tube, or an "ATR".

COMPLETE CIRCUIT

Fig. 6 depicts a duplexing system using an ATR tube in conjunction with a T-R tube for effective antenna switching. The ATR tube is a resonant, gas-filled device constructed in a manner similar to that of the T-R tube, but with only one coupling loop or iris.

It is placed on the transmission line between the magnetron and the T-R in such a manner that it has no effect on the passage of the transmitted signal, when it is ionised, but constitutes a high series impedance to the received signal in the unfired condition.

The line length between the T-R and the ATR is then chosen so that the received signal "sees" a high impedance toward the magnetron regardless of the cold impedance of the latter.

T-R and ATR tubes are used in a wide variety of forms adaptable to both coaxial transmission lines and waveguides.

SONGSTER
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PICK-UP & PHONO NEEDLES

COIL DETAILS FOR SMALL RECEIVERS

(Continued from Page 49)

32 B&S gauge DSC, and so on. Wire requiring greater winding space may make the broadcast coil too long to fit on to the former.

The broadcast reaction winding must use fine wire to allow the required number of turns in the small space at the grid end of the secondary.

Wire gauges for the other bands are less critical, since winding space is not a problem. However, the specification should be followed as closely as possible.

Unless otherwise stated, all coils are normally wound in the same direction. The normal connections are as follows: Top of reaction winding to the "earthy" side of the circuit, bottom toward the plate or screen. Top of the secondary winding toward the grid, bottom to earth; top of the primary winding to the aerial or to plate, as the case may be, bottom to earth or to B plus.

SIMPLE RECEIVERS

For simple receivers having no RF stage the coil will consist of an aerial primary winding, secondary winding, and reaction winding. The arrangement of the windings on the former is shown in the accompanying diagrams, the one on the right applying to most of the lower frequency band coils and that on the left showing the general style for the higher frequency bands where space winding and interwound winding is used.

In the case of a set using an RF stage there will be some re-arrangement of the various windings. The aerial coil will now consist of two windings only, one wound to the "aerial primary" specification and the other to the "secondary" details. The RF coil will have three windings, wound according to the "RF primary", "secondary", and "reaction" data.

In order to ensure perfect tracking between the two stages each coil should have exactly the same inductance and any stray capacitance in either circuit will need to be balanced out by means of trimmer capacitors. Failure to match the two coils will cause poor tracking—and poor performance—at the low frequency end of the band and render it difficult or impossible to peak the trimmers at the high frequency end. Stray capacitance, if not corrected by means of trimmers, will cause poor tracking at the high frequency end of the band.

The presence of the trimmers across the coils will restrict the tuning range slightly and alter the coverage, so we have shown the coverage to be expected both with and without trimmers. Naturally there is no point in using trimmers where only a single stage is employed.

For larger TRF receivers requiring an aerial and two RF coils all three secondaries must be identical. In such sets the reaction winding is usually omitted.

The coil former shown in the diagram is fitted with six pins which are designed to suit a standard six pin valve socket. This allows the required band to be selected by simply plugging in the appropriate coils. It is not particularly important what arrangement of pins is used for the various connections, providing they are the same for all the coils and the sockets are wired to correspond.

SIMPLE FORMERS

Where it is desired to provide one band only, such as the broadcast band, there is no need to use the plug-in type of formers and less expensive types, intended to be permanently mounted, may be used.

In the accompanying winding scale the coil to cover approximately 79 to 256 metres is probably the least important. There are very few worthwhile stations in this band and the data is included mainly to make the table complete. For reception much above 30 Mc simple receivers are not very efficient and a somewhat different approach is required. The coil data also becomes more critical and dependent on the circuit wiring and layout.

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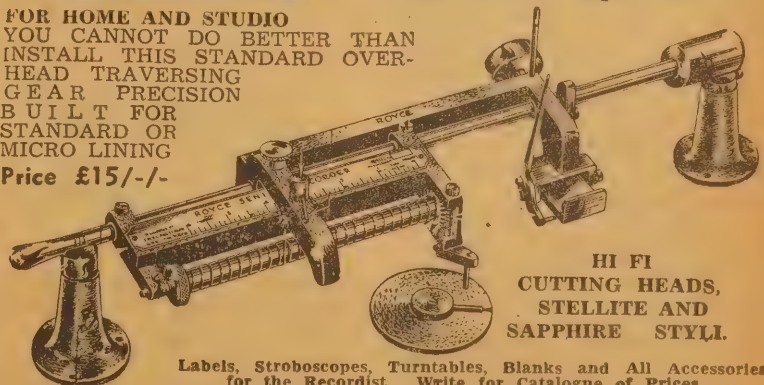

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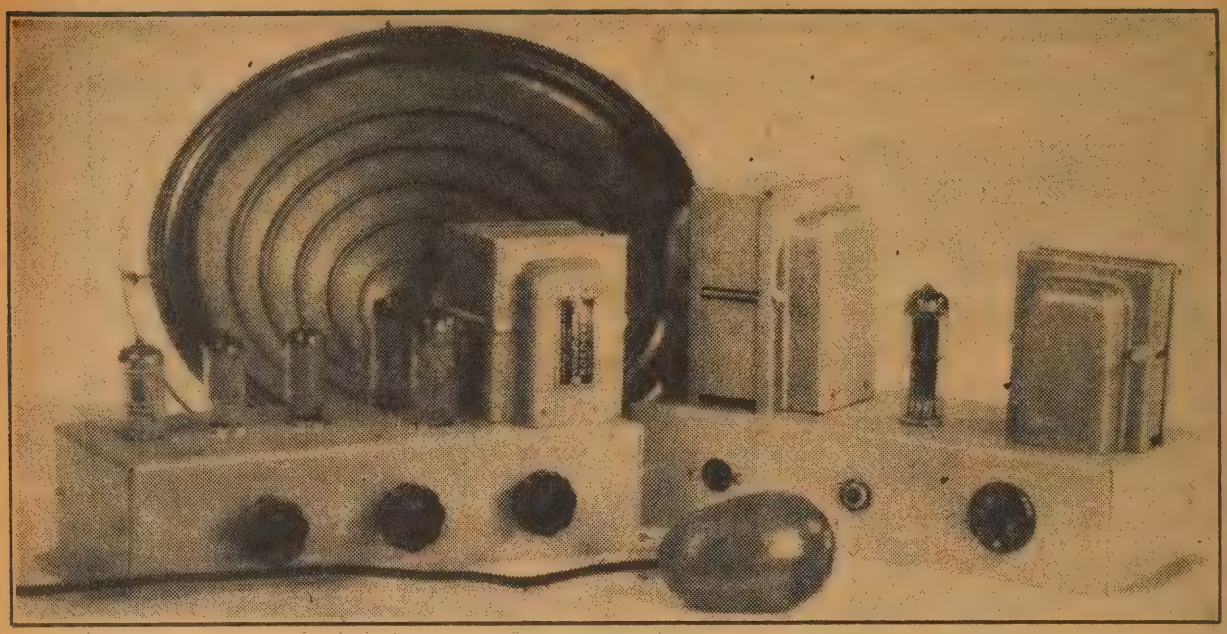

Here is a view of the complete P.A. system before being fitted into a carrying case. The control knobs will normally carry scale plates marked "microphone", "pick-up", "tone" respectively. The controls are from the left in the order just mentioned. The input, output and switch on the power supply chasssis normally face rearwards when in the case.

PORTABLE 10-WATT P.A. SYSTEM

Here is an amplifier intended especially for the public address enthusiast. Designed to fit into a small carrying cabinet, together with one 12 inch speaker, this complete P.A. system should appeal to the individual freelance P.A. man or to religious, sporting or political bodies in general. It is capable of a nominal 10 watts of audio power and has a mixing circuit to fade music to speech or vice versa.

by Raymond Howe

WE have described many amplifiers in the past which could be used for public address work with varying degrees of modification. However, we have had many requests for a design of a complete portable public address amplifier which would fit into a single carrying case.

Our new amplifier will fit into one case, of approximate dimensions 14in by 12in by 8in. It is intended for voice reinforcement at fairs, chocolate wheels, political and religious meetings and such like. It will also assist masters of ceremony at functions, artists on stage, amplify recordings for small hall dancing and brighten up parties in the home.

INPUT CHANNELS

Two input channels are provided, one for a microphone and the other for a pick-up with which to provide background music to a stage presentation or simply to amplify music. Each input channel has its own volume control and both controls are combined in a simple mixing circuit so that the level of speech and music can be adjusted to suit.

From experience it has been found that some control on the treble response is handy to round out imperfections in untrained voices, especially when using an inexpensive microphone. We have fitted a simple control to this amplifier for that purpose.

The sensitivity of the pick-up channel has been deliberately arranged so that it can also be used as a microphone channel under close-talking conditions, with a sensitive microphone such as a dynamic or a high output crystal.

This last facility is extremely useful for off-stage effects or any other situation demanding two microphone channels.

The amplifier and power supply chassis are intended to mount one above the other in a framework and panel which will form one face of the carrying case. The speaker will be fastened in the remainder of the case which will act as a form of mounting and baffling. The two parts will slip together to be held in place for carrying with a couple of clips.

CABLES IN CASE

The power cable, speaker extension leads and microphone head will fit into the case but such accessories as an extension stand for a microphone and turntable and pick-up would have to be carried separately.

The convenience of a single unit for the main portion of a portable system is rather an important one where, in some cases, it may have to be carried in public transport or taken through a crowded hall to the stage. It also avoids the annoying chance of leaving behind one small though vital accessory.

At a later date, we will give the constructional details of a suitable carrying cabinet and will also de-

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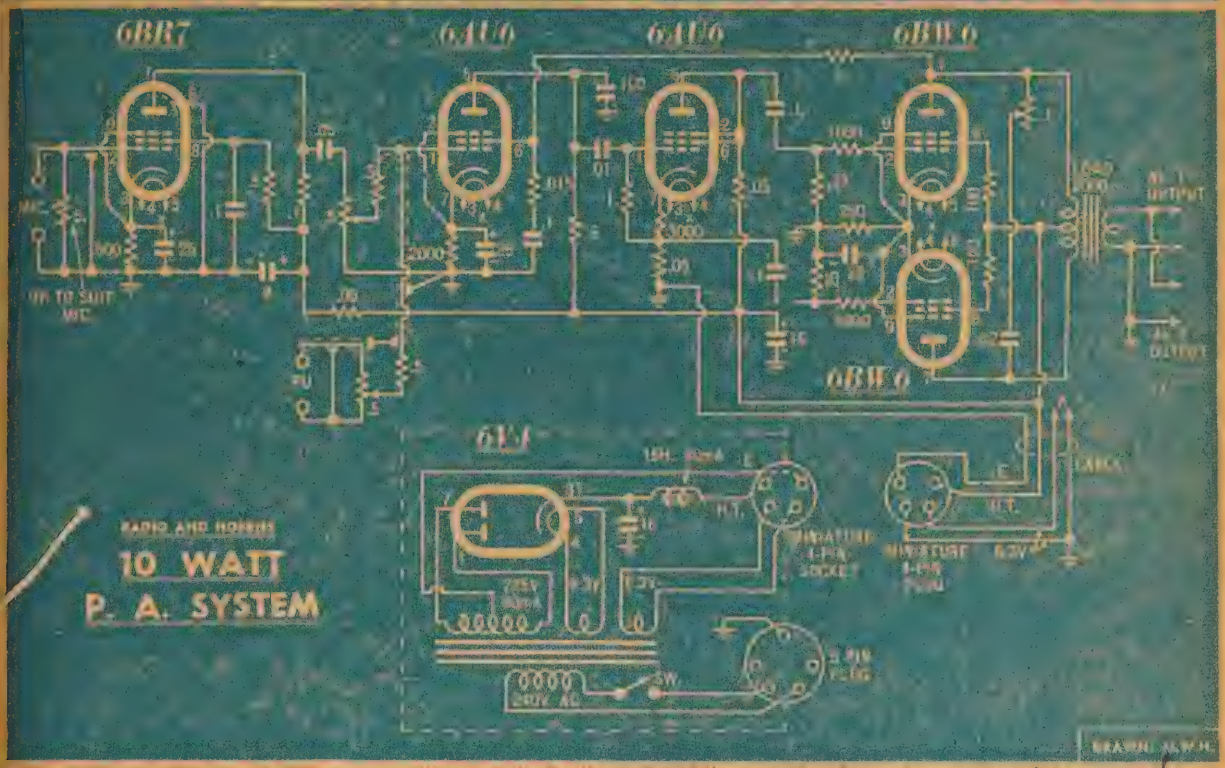

Here is the complete circuit of the power. Note that the 5-volt winding of the power transformer is not used and, hence, not shown. Note also that for the sake of clarity the selection of secondary tappings on the output transformer is not shown. The lower end of the pickup control is returned to chassis through the shielding braid.

scribe a dual power supply which will operate the PA unit from either a car battery or the AC mains.

An appropriate cable will connect either primary source to the power supply unit and a switch will select the corresponding source. It will be wired in such a way that no damage will be done with the switch in the incorrect position.

The chassis for the dual power supply will be the same as for the AC version described here. This is why we have shown the current power supply with a high tension switch and a plug-and-socket connection for the flex to the power mains socket.

OPTIONAL FITTINGS

These items could be omitted if desired, taking the flex into the chassis through a rubber-grommeted hole direct to the transformer primary winding. A power extension lead could be carried in the case, if the permanently connected power lead proves of insufficient length on some occasions.

The power to the amplifier proper is taken from the power supply through a miniature 4-pin plug and socket.

Previous experience suggests that in most cases the system will be used with one large speaker strategically placed. However, we have provided for two speakers and, if need be, more could be added with a little manipulation of the output plug wiring.

For this reason, we used an output transformer with multiple secondary tappings within the range from 2 ohms to 15 ohms. The two miniature 4-pin output sockets are wired in parallel with one pin as common and the other three pins carrying 2 ohms, 8.4 ohms and 15 ohms as an optimum arrangement.

You will probably need to adjust this combination to suit the speakers which you have on hand or intend to purchase. It is a good idea to arrange things so that the reflected load to the valves will be above optimum with one speaker connected and below optimum with two in circuit.

The point is that the optimum load impedance for these valves is 8000 ohms centre-tapped and the nearest available output transformer impedance appears to be 10,000 ohms centre-tapped. With two speakers in parallel, this could be reduced to 5000 ohms, which would still be near enough in practice.

The output transformer has to be mounted on the amplifier chassis for a couple of reasons. One is that we just could not have output valve plate leads running all over the place for fear of parasitic oscillation and general audio instability. The other is that if the speaker plug is accidently pulled out with the

PARTS LIST

2 Chassis 9½in x 4in x 2½in.
1 Power transformer 285V a side at 80 mA, 6.3V 2A, 6.3V 2A.
1 15H, 80mA filter choke.
1 output transformer (15 watt) 10,000 ohms push-pull with tapped secondary ranging form 2 ohms to 15 ohms.
4 9-pin and 2 7-pin miniature sockets, 3 4-pin miniature plugs and sockets, 1 5-pin plug and socket.
2 Shielded microphone connectors, 1 S.P.S.T. toggle switch.

VALVES

1 6BR7, 2 6AU6, 2 6BW6, 1 6V4.

CAPACITORS

3 25 mfd 40PV electrolitics, 2 16 mfd 525PV electros., 1 8 mfd 525PV electro., 4 .1 mfd, 1 .05 mfd, 1 .02 mfd, 1 .01 mfd (paper tubulars are miniature 350VW or higher) 1 100 pf.

RESISTORS

1 5 meg. ½w., 1 1 meg. 1w., 1 1 meg. ½w., 2 .5 meg. potentiometers, 2 .5 meg. 1w., 2 .5 meg. ½w., 2 .25 meg. ½w., 1 .1 meg. 1w., 1 .1 meg. potentiometer, 2 .05 meg. 1w., 1 .05 meg. ½w., 1 .015 meg. ½w., 1 3000 ohm ½w., 1 2000 ohm ½w., 2 1000 ohm ½w., 1 500 ohm ½w., 1 250 ohm 3w. wirewound, 2 100 ohm ½w.

SUNDRIES

3 5-tag and 2 2-tag mounting strips, 3 ½in i.d. and 3 5-16 ind. rubber grommets, 1 ft. shielded hook-up wire, 3 knobs, hook-up wire, solder, solder lugs, spaghetti sleeving, nuts, bolts.

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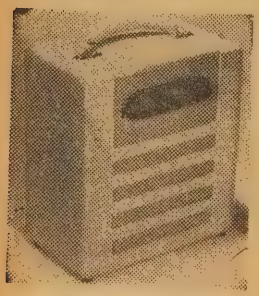

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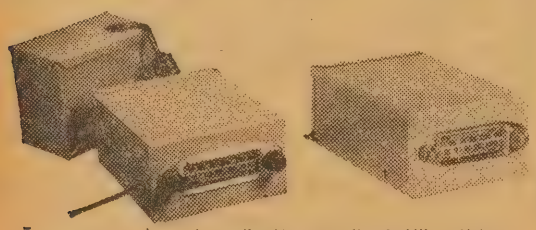

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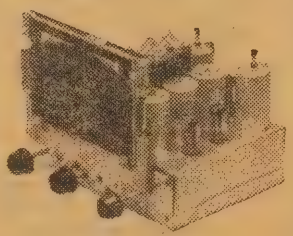

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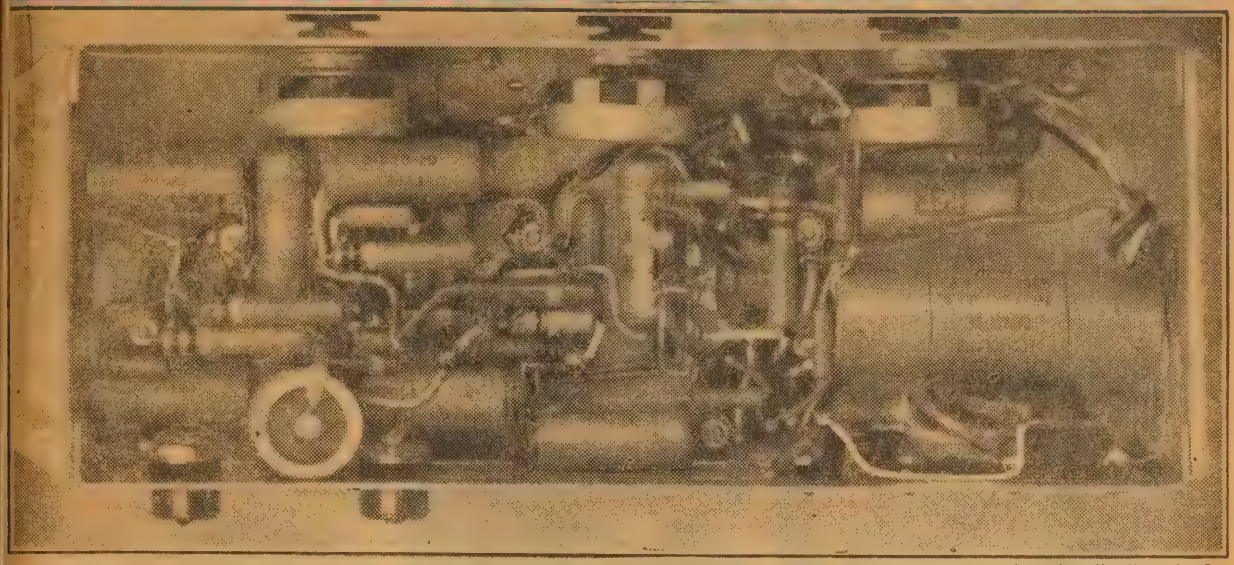

The limited space underneath the chassis will call for a little thought in layout. Keep away from each other the "hot" end of plate and screen resistors of adjacent stages and these resistors and grid resistors of individual stages. Make allowances for possible protrusion of the speaker magnet into the chassis rear when fitted into the carrying case.

amplifier in operation by tripping over the lead or otherwise, the open-circuiting of the primary winding would damage the output valves.

The usual practice, then, is to extend the secondary winding to the speaker whether it be at voice coil impedance or line impedance.

It is wise to use, say, plastic-covered power flex for the connection to the speaker from the point of view of reasonably low DC resistance and serviceability under usually adverse conditions.

The former point is one which needs to be considered when using a speaker having a 2 ohm voice coil impedance. Appreciable DC resistance in the leads connecting to the speaker would only dissipate useful audio power.

In contrast, speakers of 15 ohm voice coil impedance are far less susceptible to this problem because of the greater ratio between the voice coil impedance and possible connecting lead resistance. Generally, however, the use of the power flex as a lead will avoid trouble in this respect with any speaker impedance for a usual length of line.

HIGHEST RATINGS

In the selection of miniature valves for the push-pull output stage, we could have used the high-slope 6M5 or 6BV7 types. We decided on the 6BW6 type, however, in view of the fact that their ratings, like those of the 6V6GT, permit slightly higher plate and screen voltages with an attendant rise by a couple of watts in the output.

These valves operate on the class AB1 rating of 285 volts from cathode to plate and screen. Allowing for the drop across the cathode bias resistor, this calls for a high tension voltage of just over 300 from the filter. Adding the drop in the filter choke, we require about 320 at the cathode of the rectifier.

We can obtain this from a 285 volt a side transformer feeding into a 6V4 rectifier with capacitor-input filter.

Although the rated power output from the 6BW7 valves in this condition is 12 watts we have rated the amplifier at a nominal 10 watts on speech or music, bearing in mind the possible variations in individual units with valves, voltages and efficiency of the output transformer.

The simple tone control is placed between plates of the two output valves and with the values should give optimum results with reasonably smooth control. Increasing the value of the capacitor in series with the tone control potentiometer will increase the treble cutting, but we do not think that you will want to go too far in this respect as it will simply defeat its own object by reducing the general intelligibility in crowded halls.

COLOR CODE FOR RESISTOR

VALUE	BODY	END	DOT
5 meg.	green	black	green
1 meg.	brown	black	green
.5 meg.	green	black	yellow
.25 meg.	red	green	yellow
.1 meg.	brown	black	yellow
.05 meg.	green	black	orange
.015 meg.	brown	green	orange
3000 ohms	orange	black	red
1000 ohms	brown	black	red
500 ohms	green	black	brown
100 ohms	brown	black	brown

We have inserted parasitic-suppression resistors in both the grid and screen circuits of both valves. We don't think that they are absolutely necessary, but they are included as a precautionary measure.

To drive the grids of the 6BW6's in anti-phase, we used a triode-connected 6AU6 in the conventional phase-splitting circuit. It is simple, reliable and the overload characteristics are adequate for the purpose.

Although any triode could be used here, it is obvious that it would need to be in the miniature series even for the sake of appearance. Apart from the 6AV6 and 6BD7 types, there is little available. The 6AU6 is more likely to be on hand and so we showed one triode-connected for this stage.

This stage is preceded by another 6AU6 in a straight pentode arrangement. A feedback loop is taken from the plate of the "top" 6BW6 through the appropriate value of screen dropping resistor to the screen of this 6AU6 stage.

SCREEN FEEDBACK

The value of the resistor between the screen and the .1 mfd bypass capacitor controls the degree of feedback. The fidelity requirements of a PA system are not as stringent as in other particular audio applications and so the main purpose of a feedback loop is merely to curb the normally high distortion of uncompensated pentodes.

We decided not to include the output transformer in the feedback loop by taking the feedback from the voice coil winding for the rather obvious reason that the conditions at the voice coil or secondary winding are open to wide fluctation with the manipulation of speaker voice coil impedances. For all that, the feedback does greatly improve the general characteristics of the amplifier and you will find, in practice, that its performance and characteristics are entirely adequate.

The simple mixing circuit for the microphone and pick-up is in the grid circuit of this 6AU6. You will note that the level from the pick-up and that from the microphone pre-

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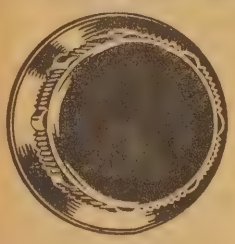

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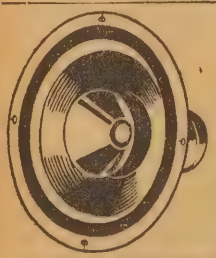

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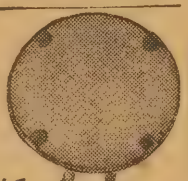

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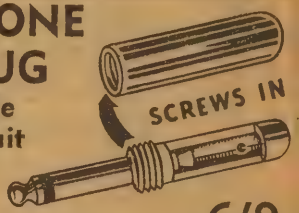

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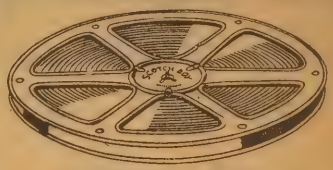

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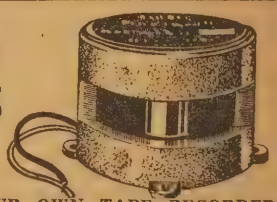

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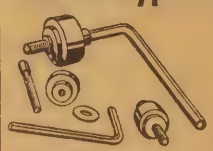

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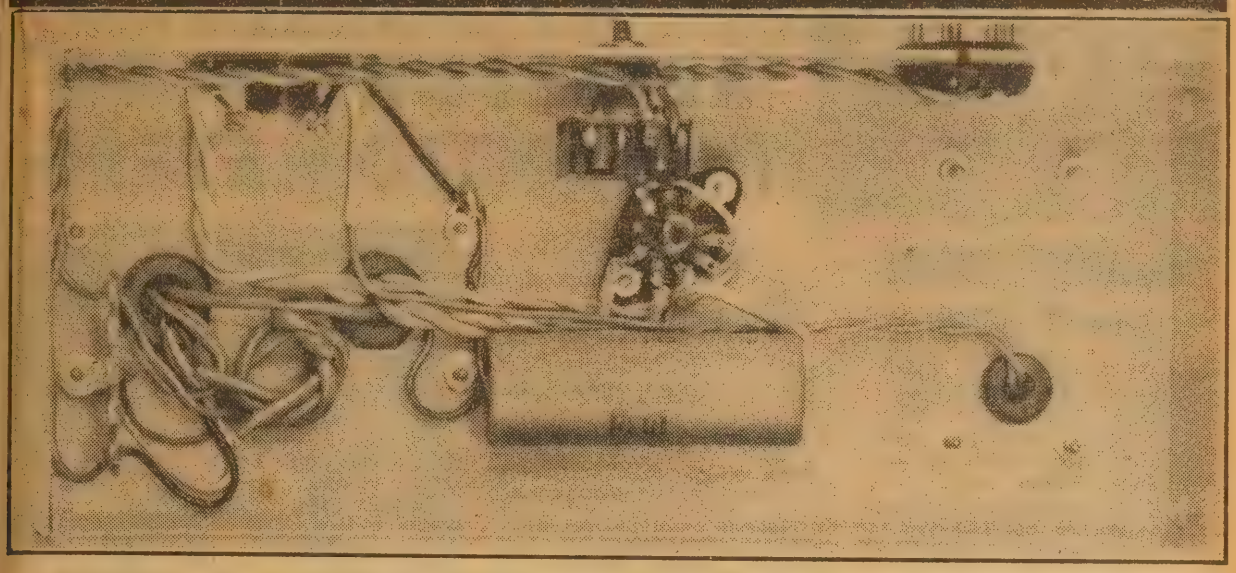


In this AC version, there is very little underneath the power supply wiring. There will, of course, be more components here with the vibrator/AC power supply to be described later. The switch shown in the centre would normally be a S.P.S.T. type.

amplifier stage are fed in parallel through individual isolating resistors to the grid of the valve.

The shunting effect of one control upon the other introduces a maximum attenuation of 6db. This does not matter as there is adequate gain for each channel. The sensitivity of the pick-up channel is around 200 millivolts.

The microphone preamplifier stage employs the 6BR7, a low-noise pentode designed especially for low-level channels. The resulting sensitivity on the microphone channel is sufficient for any microphone, used with input transformer where applicable, to drive the amplifier to full output.

The grid resistor for this stage is marked as 5 megohms or to suit the microphone. The 5 megohm value suits a crystal microphone. Though the grid return for a dynamic microphone with input transformer would be through the DC resistance of the secondary winding, a resistor should always be in circuit to avoid leaving the grid floating if the channel is left open.

HUM VERY LOW

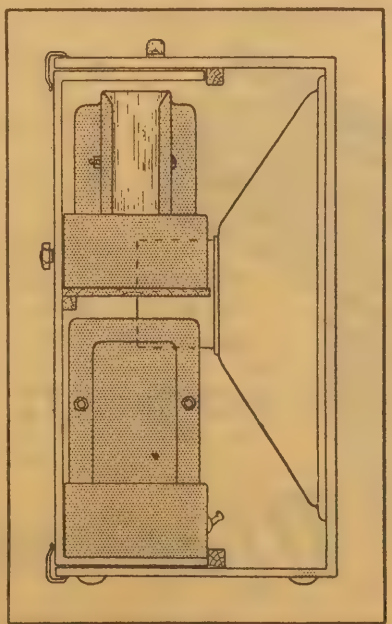
The plate and screen feed to the preamplifier stage is decoupled with an 8 mfd electrolytic and a .05 megohm resistor to avoid amplification of high tension line hum from the grid of the first 6AU6 onward. As it stands, the background hum of the amplifier is extremely low for PA purposes.

The chassis used for the amplifier unit and the power supply will be blueprinted and the ready-made version should be available through the usual channels very soon after you read this. You would be wise to lodge an order as early as possible with your particular radio supply house, as the demand has a bearing on the rapidity with which they appear on the shelves.

There is very little to the wiring of the power supply chassis. It is simply a matter of connecting the transformer secondary leads, one side of the filter and a 16 mfd electrolytic capacitor to the 6V4 socket and taking the filtered DC and the second 6.3 volt winding to the 4-pin output socket. Note that the second 16 mfd capacitor is wired into the amplifier chassis.

The unused 5 volt winding can be taped off and rolled up out of the way.

Though not necessarily essential in this case, particular orientation of the valve sockets in the amplifier can lead to easier placement of the minor components around the sockets. There's not a great deal of space to spare so it will be worthwhile giving some thought to this. The underchassis photograph will give you a rough idea of where most of the components fit in.



Here is a side elevation of the intended layout within the carrying case.

This is how we arranged the valve sockets: 6BR7 with gap between pins 1 and 9 toward the adjacent chassis end, both 6AU6 with the gap between pins 1 and 7 toward the input connectors, the rear 6BW6 same as 6BR7, front 6BW6 with gap toward the output sockets.

Place solder lugs under all valve sockets bolts and connect them together with a run of light gauge tinned copper wire. Connect together the appropriae pins of each socket and earth the centre spigot.

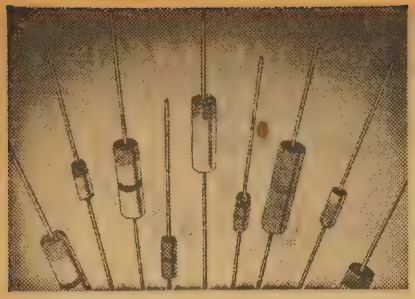
Use tag-mounting strips where applicable to hold components in place. You will find it much easier if you use ½ watt resistors where mentioned in the parts list. If in doubt here, remember that we have used 1 watt resistors in plate and screen feeds only, including the .05 between cathode and chassis of the phase-splitter.

MIXER COMPONENTS

Use shielded hook-up wire for the connections between the input connectors, controls and valve sockets. We set the microphone control with the lugs toward the bottom of the chassis and the pick-up control with the lugs toward the microphone control. With this arrangement, the .5 megohm ½ watt resistors from the moving arm of each control lay against the chassis and the grid connection made to their junction through shielded wire.

To allow the knobs to fit as close as possible to the chassis face, we spaced the controls, the potentiometers, away from the chassis with two washers cut from 18 gauge aluminium.

The unused tappings of the secondary of the output transformers are coiled up and tucked between the two output sockets taking care to avoid shorting to the chassis. If you cut these leads to shorten them, make sure that you clean and solder the two ends in the one spaghetti sleeving to retain continuity in the winding.



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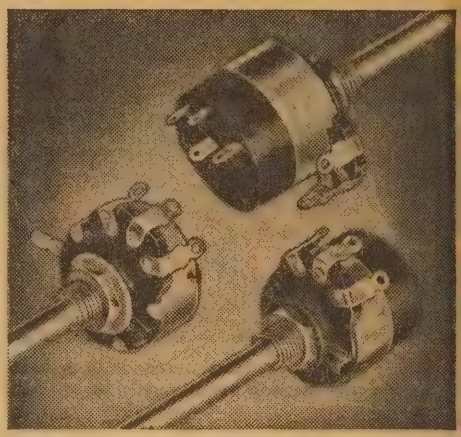

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FROM THE SERVICEMAN WHO TELLS

After last month's digression I am back in my own environment, battling with the community's radio receivers. Even here, I'm afraid, all is not plain sailing and the question of set design, rather than the replacement of components, has to be considered all too frequently.

A CASE in point was a mantel set encountered recently.

The owner, an elderly lady, complained that the set whistled, though she pointed out that it did not always do it and the effect came and went for no apparent reason. She also complained that the general performance, in particular the "tone", was not as good as other sets she had heard, and mentioned that the set had already been to one serviceman, who seemed unable to fix it.

Visualising an intermittent of some kind I switched on and commenced checking. The set performed after a fashion, though it was not very impressive. There was no sign of actual oscillation, though there was a definite "swishiness" which suggested that it would oscillate at the slightest provocation. There was also some distortion at low volume and a definite minimum volume effect.

It was while I was checking the various controls that I happened to switch the tone control to the bass position, whereupon the set immediately burst into oscillation. This, apparently, was the explanation of the supposed intermittent effect, the owner being unable to associate the whistles with a particular setting of the tone control. It ultimately transpired that she preferred the control in the bass position, no doubt to minimise the distortion at low volume.

LONG LEAD

Removing the chassis from the cabinet, I commenced to trace the circuit in an effort to discover why the setting of the tone control affected the stability. Main reason appeared to be due to the tone control forming part of the detector circuit, plus the fact that a long lead ran from this point to the pot on the front of the chassis. Seeing that the set was already on the verge of oscillation this was clearly the "last straw" that spilled it over.

I also discovered the reason for the minimum volume and distortion, for it did not take long to realise that the set was a reflex and these characteristics are typical of the reflex circuit. (I do not like reflex sets.)

Main reason for the minimum volume effect is the presence of an audio load as well as the usual IF load in the plate circuit of the IF valve. This means that any audio component in the IF valve plate circuit, from whatever source, will appear across the audio load and be passed on to the following stage.

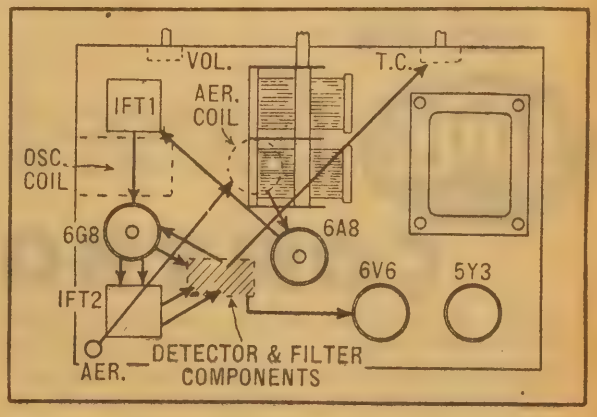
Ideally, the only audio signals present in the plate circuit should be those due to the audio signals impressed on the grid from the detector stage but, in practice, this ideal is very difficult to achieve.

No valve is a perfect amplifier and no matter how carefully the operating conditions are chosen there will inevitably be some non-linearity in the amplifying characteristic. Thus a certain amount of detection will take place during the IF amplifying process and before the signals are passed on to the diode circuit for the normal detection process.

The audio component resulting from this will appear across the audio load and finally in the loudspeaker. The setting of the volume control will have no effect on it because this part of the circuit has been completely bypassed. The condition is also aggravated by reason of the unfavorable operating conditions imposed on the IF valve, due to the audio load in the plate circuit and the reduced plate voltage.

By careful design and selection of the valve operating conditions it is possible to reduce these defects to the point where they are not serious, even though they may never be completely eliminated. Unfortunately, many receivers of doubtful origin lack this care in design and the performance can only be described as plain woeful.

The receiver now on my bench was one such and I realised that, short of completely redesigning it, there was little prospect of improving it. The best I could hope for was that I could cure the oscillation. But I soon realised that this was not going to be so easy either, for the layout of the set was one of the worst I had encountered for a long time.



A combination of a reflex circuit and the above rambling layout was responsible for a severe case of instability. Note the path which the signal is forced to take and the possibilities which are presented for unwanted coupling. The tone control lead was the last straw, and the set would oscillate in the "bass" position.

I checked all the by-pass condensers, operating voltages, position of potentially "hot" leads, and even went so far as to try some additional shielding, but finally had to admit that nothing I could do was of any avail, and that the trouble was clearly the cumulative effect of several unduly long and badly-placed leads.

Had it been a case of one lead only being the offender it would probably have been a simple matter to re-route it, but with most of the leads in the front end of the set contributing something to the trouble it was obvious that nothing short of a complete re-design would be effective.

Since this was clearly out of the question it was obvious that I would have to find an easier way. A check on the alignment showed that this was not perfect, the IF's being slightly off tune and when I tried to peak them I knew why, for the set became hopelessly unstable, regardless of the setting of the tone control.

PROBABLE HISTORY

I was now beginning to build up some kind of picture of the history of the set. The previous serviceman had apparently come to much the same conclusion as myself, namely that only a complete rebuild would really cure the instability. This being out of the question he had adopted the course of slightly detuning the IF's to the point where the set was just stable, reasoning that the performance was still adequate and that it was the best way out of a bad job.

Unfortunately, and understandably perhaps, he had neglected to check the performance with the tone control in the bass position, with the result that when the owner tried to use it this way it became unstable. In the circumstances, I could see no better way out of the problem than to simply detune the IF channel a fraction further until the set was stable under all operating conditions.

When this was done the performance, in terms of sensitivity and selectivity, was still more than adequate and I felt that this approach was justified.

With the stability of the set assured I was forced to admit that there was little more I could do to improve its performance.

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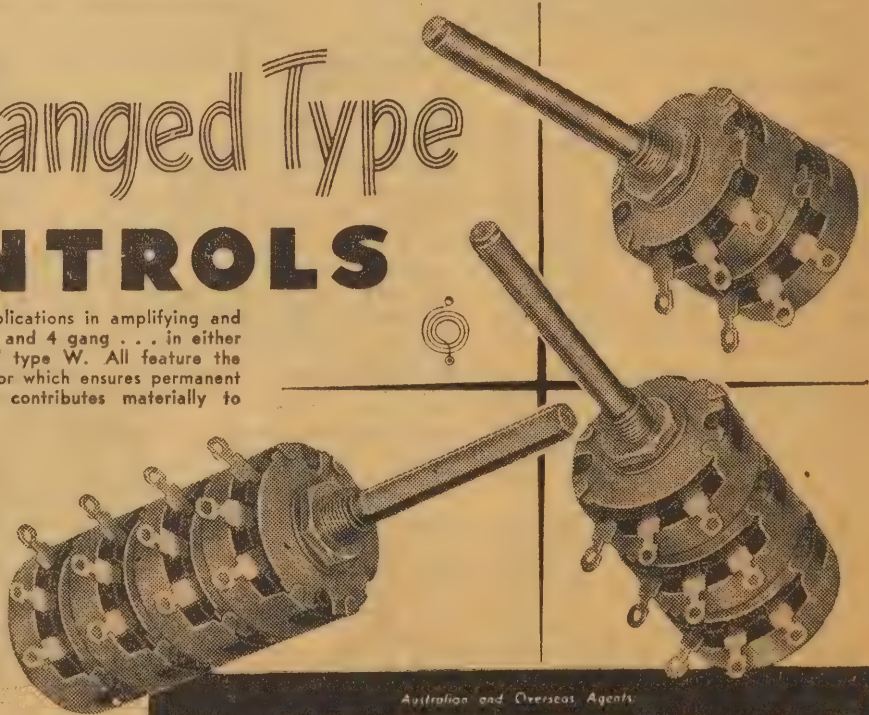

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to the owner that the other faults were due to poor design and that there was no cheap way of overcoming them. This explanation was readily accepted and I was thanked for the explanation and short instruction I was able to give on how to get the best performance out of the set, considering its limitation. So everyone was happy, but I couldn't help feeling that this particular set was a classic example of a reflex set at its worst.

ANOTHER CASE

The incident brought to mind another example of how not to build a reflex set (if one must have a reflex set). This set was an elaborate console by a well-known maker and was a five valve circuit which, with the reflex feature, certainly resulted in very high sensitivity.

Because of this high overall gain the minimum volume effect was something which just could not be ignored, and the makers had fitted an RF gain control to reduce the signal strength at the second IF to the point where it was not objectionable. The regular audio gain control was also fitted and an additional feature was a magic eye tuning indicator.

There was no doubt that the set was capable of an excellent performance—provided it was tuned by someone who could work out the best ratio of RF gain to audio gain for a particular station. As it was, the owners, an elderly couple, were completely and hopelessly bewildered by the array of knobs and their attempts to tune it usually resulted in the most horrible distortion.

The salesman had apparently told them that the magic eye was to assist the tuning and that stations would be correctly tuned when the eye was closed.

EFFECT OF RF CONTROL

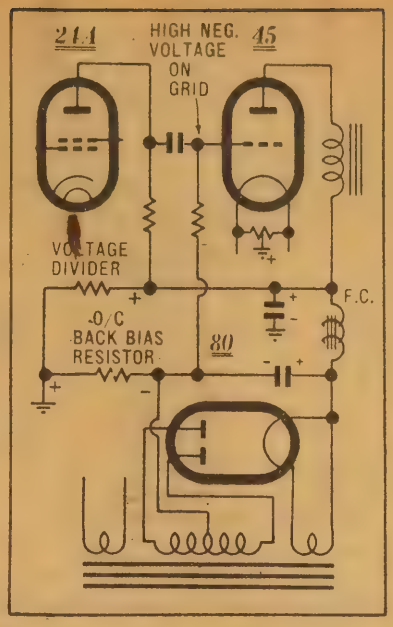
However, everyone seemed to have overlooked the fact that the image of the eye could also be controlled by the RF gain control, so that their usual tuning procedure was to set the tuning control to some point to one side of the station and then advance the RF gain until the eye closed. The result is probably better imagined than described.

It was also possible to produce the most colossal distortion by reducing the audio control into the minimum volume region and then use the high RF gain to blast a signal through by sheer brute force. At the other extreme, distortion was also produced when the audio gain was flat out and the RF gain reduced, mainly due to the diode detector being operated under the most unfavorable conditions of signal input.

With all these possible combinations let loose with non-technical owners it was little wonder that the set always sounded terrible and, although I tried my best to explain how the controls should be used, I realised from the start that it was hopeless, the owners being completely unable to grasp what it was all about.

The designer might well have considered this angle of his design in preference to spending a lot of time getting a few more microvolts from a given number of valves, particularly when this extra sensitivity would probably never be used.

I'm afraid all this may add up to a criticism of the other fellow's efforts. If so, it will have to stand because, in point of fact, a serviceman's life is spent in restoring existing devices to an original state of perfection.



This is the circuit of the back bias section of the receiver which stumped me for a few minutes. With the back bias resistor open the chassis was located close to the positive side of the HT supply, making the grid of the 45 negative by almost the entire HT voltage.

Another set I handled this month was a real old-timer and, significantly enough, it produced a typical old-time fault. So old, in fact, that I must confess it floored me for a few moments.

The vintage of the set is best indicated by the valves it used. The ones in which I was mainly interested were the rectifier, power valve and detector, being types 80, 45 and 24A, respectively.

The set as I received it was completely dead, with that absolute silence which suggests that something quite drastic has happened to its "innards". My first impression was that there would probably be no HT voltage and I accordingly made my first check across the first filter condenser. Contrary to expectations there was voltage here, but I immediately became suspicious when I realised that it was somewhat on the high side.

The symptoms — excessive HT voltage and a completely dead speaker—now suggested an open circuit speaker transformer, and I fully expected to find no voltage on the plate of the 45. But I was wrong again; not only was there voltage there, but the presence of the test prod produced a distinct click in the speaker, thus indicating that the speaker was functioning correctly.

Next check point was the plate and screen of the 24A, lack of voltage on either of these being capable of producing similar effects. Both voltages were quite normal, but there were no clicks from the speaker when I touched the test prod on either point. I knew what the trouble was now; the 45 had "had it". The lack of current obviously caused the excessive HT, while it also explained the lack of any signs of life.

FINAL CHECK

Just to make sure, I placed the prod on the grid of the 45. There was no click from here either, and the needle kicked backwards. That was all right except that the backward kick seemed much too violent to be caused by the few volts of bias as measured through the grid resistor. I reversed the prods and measured the voltage again, receiving something of a shock when the meter registered a figure nearer the HT voltage than the bias. Then, quite suddenly, I remembered.

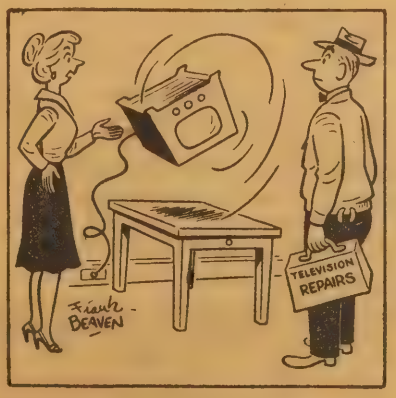
Back in the good old days, before resistor manufacturers bothered much about the finer points of design, a common fault was an open circuit back-bias resistor, and it produced all the symptoms I have just enumerated. The main reason I had gone so rusty on the trouble was that it seldom happens nowadays. Whatever other caustic remarks one may be tempted to make about components these days, it must be admitted that our manufacturers can at least turn out a good quality wirewound resistor.

THE BACK BIAS CIRCUIT

In order to appreciate exactly what happens when the back-bias resistor opens, it is necessary to analyse a typical back-bias type power supply. First point to appreciate is that the centre tap of the power transformer, being the negative side of the voltage generating source, is the most negative point in the system. The back-bias resistor, being located between the centre tap and chassis, moves the chassis a few volts toward the positive side of the system.

The power valve cathode is connected to the chassis and the grid to the transformer centre tap, placing a voltage between these two equal to that generated across the back bias resistor and with the negative side to the grid.

Another way of visualising it is to regard the back-bias resistor and the voltage divider as one resistor (or voltage divider) with the chassis connected to a tapping a few volts away from the negative end. The further away from the negative end we move this tap the more positive it becomes, which is only another



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894-23	500	2, 3.7, 8, 12.5	2	50-10,000	5	LINE TO VOICE COIL	26/3
900-22	2500, 5000	2, 3.7, 8, 12.5, 15	1	*40-15,000	15	SINGLE 807, EL34 ETC, TO VC	57/6
896-9	8000, 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR AB1 TO VC	62/6
897-9	8000, 10,000	100, 125, 166 250, 500	1	30-15,000	15	PP 6V6G's A OR AB1 TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR AB1 TO VC	62/6
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL	42/6
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1371-8	200-220-230-240	500-600-750 850-1000	300		150/-
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956-1A	30	20	200	160	1000	57/9
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way of saying that the larger we make the back-bias resistor the larger the voltage (or bias) generated across it.

The open circuit back-bias resistor is an extreme case of increasing its value, and the chassis now becomes positive by an amount equal to the total HT voltage. Even if there is no actual voltage divider to provide connection between the chassis and the HT line, exactly the same effect will be provided by the early valves of the set, which are normally self-biased and will therefore draw some current.

And so, instead of a new speaker transformer or power valve, the customer was only out to the tune of a small wire-wound resistor—plus my own fee, of course! (After all, if I didn't eat, who'd write the Serviceman Page?)

PORTABLE PA

And, finally, there is the story of a portable PA system. One of the features of this device was that it could be operated from either the 240-volt AC mains or a 6-volt accumulator, and it was really this feature which contributed to its downfall.

In order to facilitate connection to either type of power supply, the unit was equipped with a seven-pin plug, mounted on the case, and on to which could be fitted one of two seven-pin sockets with a pair of leads terminating in either a three-pin power plug or a pair of battery clips. Obviously each set of leads was wired to an appropriate group of pins so that connection to the correct input terminals of the power supply was automatic.

Another function which was performed at the same time was the rearrangement of the filament connections, these being required to connect direct to the battery in the case of six volt operation, but to the transformer winding for mains working. This was accomplished by means of suitable links between various socket pins and was, therefore, also taken care of quite automatically when either power lead was fitted.

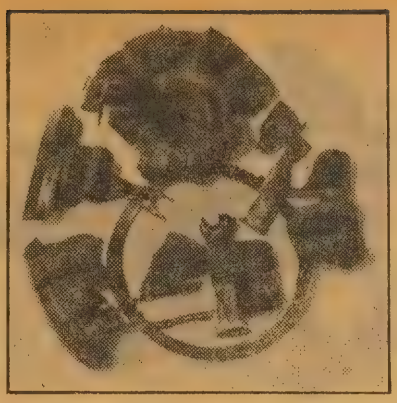
FOOL PROOF?

At first glance it would seem that such an arrangement was virtually foolproof and it might be difficult to imagine that any harm could come to it, even in non-technical hands. Doubtless that was what the designer thought, too, but subsequent events were to show how careful one must be in designing such devices.

The weak point of the scheme is the fact that it is possible to partially insert a seven-pin plug into a similar socket in any one of the possible seven positions, the angular spacing between all pins being the same. Admittedly the two larger "filament" pins will not allow the plug to be inserted completely, but they cannot prevent the remaining pins entering far enough to make contact. In fact, even these two larger ones will often make contact if the socket is a little worn.

Even this fact would not cause any bother if the operator could always be relied upon to make this connection first and then plug the lead into the mains, because power would not then be applied until the correct fitting had been made.

Unfortunately — for the amplifier



All that was left of the seven pin socket after the overload. No amount of cleaning was of any avail, several vital pins being shorted by the carbon formed when the socket first flashed over. The plug was in much the same condition.

—this was not so and an obvious and alternative procedure was to connect the lead to the mains and then make a few exploratory probes at the plug until the correct position was found.

If the wrong connections happened to be made in the process, it was just too bad!

The first time I encountered the device, it had failed for the very good reason that the mains connections had become entangled with the filament circuit. Result: A complete new set of valves. I realised at the time the weak point in the plug and socket scheme and pointed this out to the owner, advising him to always connect the cable to the unit first and then to the mains.

BACK AGAIN

Unfortunately, bad habits die hard, and it was not long after that the device was back in my shop, completely inoperative, and with much the same tale of woe. Someone had again tried to connect the cable with the power on but the only result was a certain amount of smoke, flame, fire and confusion (to put it briefly), after which the unit refused to work when properly connected. The fact that it had blown the main power fuses was one very good reason, and the owner decided to bring it to me rather than tempt fate any further.

Although it was not exactly clear what had happened, it was immediately obvious that the mains had been applied across a very low resistance circuit and that the resultant arcing, &c., for the fraction of a second before the fuses went, had deposited a thick layer of carbon on the plug and socket.

In an effort to determine just how much more damage had been done, I cleaned the carbon from the plug and socket, connected the two together correctly, plugged into the mains, and switched on. It promptly blew the fuses on my test panel and showed obvious signs of distress around the plug and socket. On closer examination, they proved to be just as badly carboned as before. It was clear that I would have to fit a new plug and socket before I could do any further testing.

BADLY DAMAGED

To remove the original plug I had to release a patent spring retaining clip and then ease the plug out of its mounting hole on a metal plate. Immediately I did so it came apart in several small pieces and shed liberal quantities of carbon dust and pulverised bakelite. It was only then that I realised how badly it had been damaged.

To avoid tracing each wire through a long cable to the "innards" of the amplifier I endeavored to reassemble the plug at least in the right order of pins, and then carefully transfer each wire to the corresponding pin on a new plug. I eventually succeeded, but all that was left of the old plug when I had finished was a handful of blackened pins with a few pieces of broken bakelite adhering.

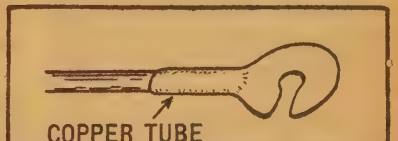
The socket was in a somewhat similar condition, though it did manage to stay in one piece — until I exerted a little pressure on it, when it, also, disintegrated.

Strangely enough, a new plug and socket was all that was needed to put the unit back in working order. The short, wherever it had occurred, had apparently not been able to do any serious damage before the fuses went.

Finally, since it seemed inevitable that someone would tempt fate again sooner or later, I painted an indicating mark on both the socket and the plug in white paint. At least that should reduce the chances of a wrong connection, though I fear that it is only a matter of time before it happens again. The whole device screams for a slotted guard ring or such like to ensure one mode of connection only.

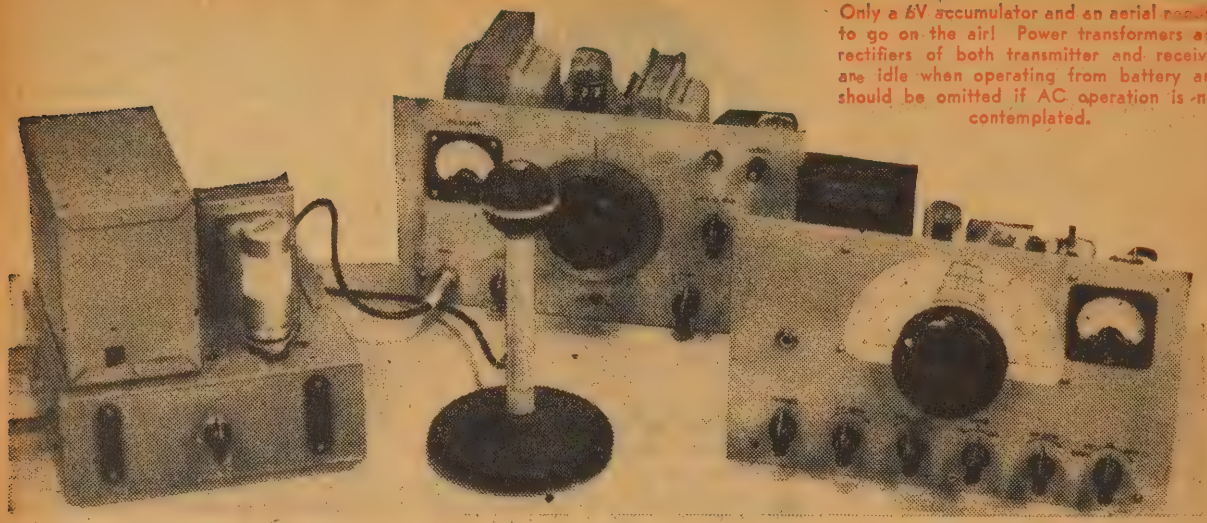
HOME-MADE SPADE TERMINAL

A suitable substitute for a spade terminal can be quite easily made with a scrap piece of soft copper tubing.



Choose a short piece of tubing of suitable inside diameter—depending on the size of wire used—and push the wire into the tube. Carefully spread out flat the other end, at the same time clamping tight a portion of the bare wire. A hole is then drilled to the required size and slotted with a hacksaw and file.

Now to make neat and finish off, cut the corners and file them round as shown in the sketch.—(K. McC., Queensland.)



Only a 6V accumulator and an aerial needed to go on the air! Power transformers and rectifiers of both transmitter and receiver are idle when operating from battery and should be omitted if AC operation is not contemplated.

The new vibrator power supply is to the left. The lead connecting it with the battery should be heavy enough to carry the supply current without appreciable voltage drop. Certain types of motor car low tension cable are suitable or you could parallel the conductors of ordinary lighting flex. The cables from the supply to the transmitter and receiver may be ordinary heavy duty hook-up wire.

VIBRATOR POWERED "HAM" RIG

With all types of mobile radio equipment in urgent demand at the present time many readers will be interested in vibrator power supplies. This article describes an economical and hash-free supply which does an excellent job of operating a communication receiver and a small transmitter from a battery. It is adaptable to either 6V or 12V and should be "just the thing" for a prospective country amateur.

by Maurice Findlay

CONSIDERABLE interest has been shown in the simple amateur equipment described in recent issues of Radio and Hobbies. You will remember that a compact two-band transmitter design appeared in the June 1953 issue and this was followed in the July issue with 6 valve receiver which was intended as a companion for the transmitter.

Our Editor described a slightly more elaborate version of the same receiver in the August issue.

We have received a steady stream of enquiries from people interested in operating equipment of this nature from accumulators. Our original interest was in work on the amateur bands but with a certain amount of mechanical modification, the equipment could obviously be adapted to applications such as bush fire control networks, motor yacht radio work &c.

OTHER APPLICATIONS

While we cannot, at the present moment, sit down and work out complete details of an equipment suitable for mounting in a fire control truck or a yacht, the information given here will be sufficient to enable a man with some radio experience to make an excellent job of such a set, especially when he has all the problems of the particular installation at his fingertips.

In designing the new vibrator power supply, we set out to solve the specific problem of operating the transmitter and receiver already described from batteries. No extensive modification was made to either and the filter choke and condensers forming part of the existing supply were used to save components in the battery supply.

The filament circuit is quite straightforward. To operate the valve filaments from batteries it is simply a matter of connecting them in parallel or series-parallel across the battery supply.

Where a set of 6V valves is operated from a 12V supply, it may be necessary to include a shunt resistor to equalise the current. Its value can be arrived at by a simple ohms law calculation.

The real problem is to convert the 6V or 12V supply into high tension at some hundreds of volts of filtered direct current.

There are two popular ways of doing this. One involves a motor-generator, the motor section of which is designed to operate at the voltage of the supply and the generator designed to deliver the high tension voltage required by the equipment.

In practice, motor-generators can be made particularly robust and reliable. They require little attention and the output is very close to pure DC so that the simplest of filters is satisfactory. Of no less importance is the fact that a well - designed motor-generator outfit produces very little radio frequency interference due to sparking at the brushes &c. A simple shield box and a few non-critical bypass condensers will render the supply completely inert as far as this is concerned.

MOTOR-GENERATORS

There are plenty of motor-generator units which have an enclosed case so that even the separate shield box is not required.

Unfortunately, motor - generator outfits are very expensive to manufacture. They require a fair amount of precise maching, accurate winding and balancing. Their reliability and other excellent characteristics made them particularly suitable for aircraft radio equipment during the war.

Large numbers are now available

from the disposals dealers, often for very moderate sums. The disadvantage is that they are mostly designed to operate from a 24 or 28 volt supply which is used for aircraft.

There were a few 12 volt types but, as their value was quickly recognised by bargain hunters, your chances of getting a suitable one are not so good. The number of 6-volt motor-generators is apparently sufficiently small to be negligible.

The alternative is a vibrator power supply. Vibrator cartridges for 4V, 6V, 12V and 24V are readily available and they can be had in self-rectifying types if required. Transformers designed for use with all popular vibrator types are stock items with most transformer manufacturers. Where greater power than can be delivered by a single cartridge is required, two or more vibrator supplies can be connected in parallel.

VIBRATOR RELIABILITY

Due to improved manufacturing techniques, present vibrator cartridges are very reliable. In commercial car radio receivers, where they are in frequent use, their life often amounts to many years. The manufacturers conservatively rate them to deliver full output for 1000 hours when used within their ratings. Thereafter, the output slowly falls off but most vibrators will have a useful life considerably in excess of 1000 hours.

The synchronous, or self rectifying, types are just as reliable as the types which require a separate valve rectifier and the overall efficiency of the system is good because there is no power dissipated in heating a valve filament. Commercial receivers often do use non-synchronous vibrators but only because it simplifies the installation problem in that the polarity of the supply is unimportant.

Where power output greater than can be delivered by standard cartridges is required, vibrators with two sets of synchronised contacts, known as dual interrupters, are available. The two sets of contacts are connected in parallel so that a separate valve rectifier is required.

Vibrator circuitry is really not as involved as many people unfamiliar with it seem to think. A vibrating reed with contacts attached is used to convery the DC from the battery into pulsating current with alternating opposite polarity. It can then be applied to a transformer and stepped up to any desired potential.

Afterward, the higher potential delivered by the transformer is rectified. A valve rectifier may be used or a second set of contacts on the same vibrating reed can be made to do the same job.

BUFFER CONDENSERS

In order to avoid excessive sparking at the contacts a set of buffer condensers is connected across the transformer windings to tune them to the frequency at which the reed vibrates.

These condensers may be connected across either the primary or the secondary winding but usually the secondary is more convenient. The buffer condensers are subjected to a great deal of electrical strain as the contacts open and close, so that a liberal voltage rating should be used.

So far, all is well. However, there is a rather sticky "fly in the ointment". The minute spark generated as the vibrator contacts open and close generates radio frequency interference usually referred to as "hash". Special precautions have to be taken to prevent this interference being radiated or otherwise getting into the input of the receiver or amplifier operating from the supply.

Do not confuse hash with the 200 cycle ripple which appears at the output of the supply. The low frequency ripple can easily be removed with ordinary iron cored chokes and electrolytic condensers in the same way as in a conventional AC supply. Actually, a given filter will usually be more effective at 200 cps than at 100 cps which is the frequency of the ripple when an ordinary full wave rectifier circuit is used.

Hash problems are usually not very difficult to overcome in the case of an amplifier or transmitter. A simple unshielded filter consisting of an air core choke and a pair of paper condensers placed in the low tension circuit is usually sufficient to prevent hash transients affecting the microphone preamplifier.

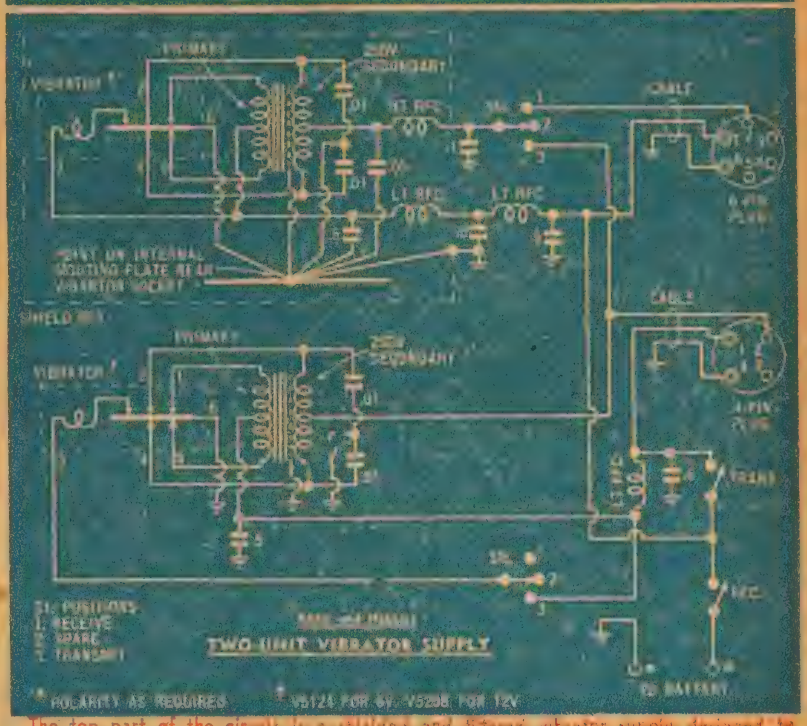
The problem is more difficult when a receiver is involved. The receiver is designed to be sensitive to radio signals but the vibrator supply which must necessarily be close to it generates a radio frequency signal covering the entire radio frequency spectrum.

HASH ELIMINATION

Before the vibrator supply can be successful with a receiver, a filter must be provided which prevents interference signals being conducted along the connecting wires and a shield which prevents them being radiated directly and being picked up by the aerial.

Because of lack of experience in this direction, many radio men and amateurs avoid vibrator power supplies. Possibly they have tried at some stage making a vibrator supply without success or they have heard reports of the virtual impos-

CIRCUIT OF THE DUAL SUPPLY



The top part of the circuit is a shielded and filtered vibrator supply designed to operate any sensitive receiver requiring 250V at 60mA. The lower part is similar, but omits shielding. The two supplies are connected in parallel to provide the high tension for the transmitter.

PARTS LIST

- 1 chassis 8in x 6½in x 3in (or similar)
- 1 shield box 6in x 5in x 3½in
- 1 mounting plate 5½in x 3in
- 2 6V to 250V vibrator transformers (or 12V)
- 2 V5124 vibrators (or V5258 for 12V)
- 5 .5 mfd 200V paper condensers
- 1 .1 mfd 400V paper condenser
- 1 .05 mfd 400V paper condenser
- 4 .01 mfd 600V paper condensers
- 3 special LT RF chokes (see text)
- 1 HT RF choke
- 1 3 x 3 rotary switch
- 2 LT switches
- 2 6-pin valve sockets
- 1 6 pin plug
- 1 4 pin plug

Rubber grommets, pointer knob, fibre washers, brass washers, nuts and bolts (4 long bolts), solder lugs, hook-up wire, battery cable, battery clips, &c.

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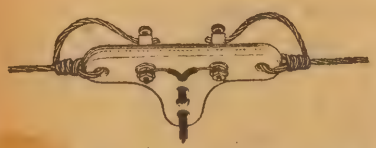

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TRADE ENQUIRIES INVITED

sibility of eliminating hash interference.

Or even if they realise that the hash can be removed, they simply accept it as one of the things that is too hard to do without specialised equipment.

Neither of the above statements is true. As proof that vibrator interference can be eliminated, there are thousands of hash-free commercial receivers in operation. At various times we have described completely satisfactory vibrator receivers in Radio and Hobbies. Appreciative letters from readers testify to the fact that our designs can be duplicated without difficulty.

The job of making a vibrator supply completely free of interference isn't simply a matter of installing more and more filter chokes and condensers or bigger and better shield boxes. There are plenty of cases where this approach will actually make the hash worse. However, the filters and shielding which is present must be arranged so that it is effective. When this is done, usually the simplest of filters will serve.

Various commercial receivers use specialised techniques which do not necessitate the use of a separate shield box but this approach is not satisfactory for the home builder who does not have full-scale laboratory facilities.

RELIABLE TECHNIQUE

Over the past few years we have developed a simple but extremely effective technique for removing hash. It can be duplicated by any home builder with certainty of satisfactory results. We admit that it isn't the only way of getting rid of the hash and do not even claim that it is the best way, but it does the job, which is the main thing that most readers will be interested in.

Here is a summary of the main requirements.

Mount the vibrator, the transformer, the filter chokes and bypass condensers on a sub-chassis or mounting plate inside a closed metal box. All earth returns for components on the mounting plate are made to a single point on the sub-chassis. The best point is usually near the vibrator socket because it allows the heavy current carrying lead from the reed to be short.

The mounting plate is insulated from the shield box except at one point, this being a heavy lead from the common point to a single point on the shield box. The outside ends of the filter chokes should be bypassed to the single point on the shield box. There should be no bypasses from the outside ends of the RF chokes to the common point on the mounting plate but rather these condensers should be returned to the common point on the shield box.

The idea behind this construction is to keep the hash potentials built up across the mounting plate to a minimum and thus make sure that there is a negligible amount of hash energy induced into the shield box.

The lead between the mounting plate and the shield box does not have negligible resistance and inductance so that a bypass from the outer end of the choke to the common point on the mounting plate is not completely effective.

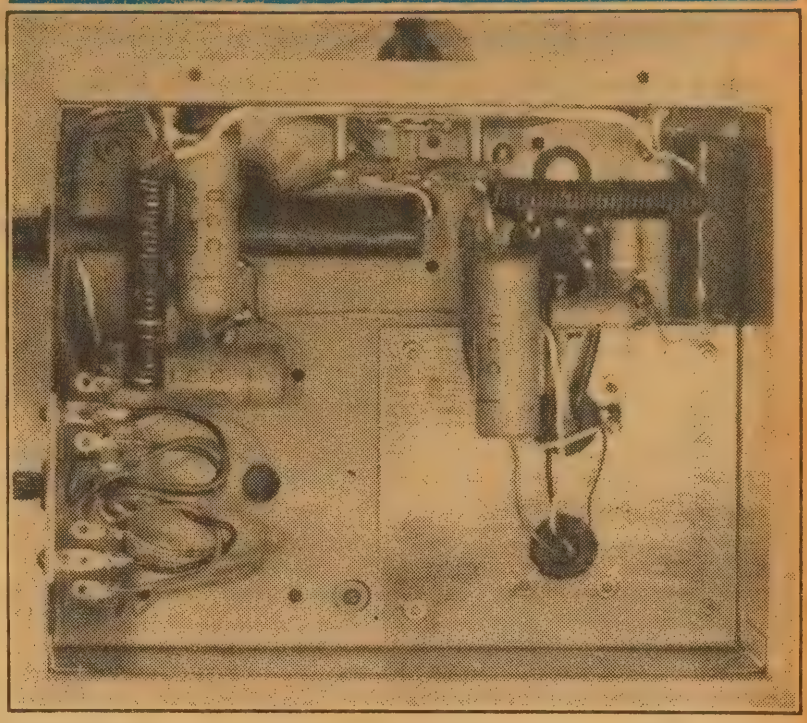
Having decided the form of the construction, it remains only to choose suitable values of chokes and bypass condensers. The high-tension choke presents little difficulty, as a unit with the required current-carrying capacity can easily be made to have adequate inductance. Likewise, there is no difficulty in finding condensers with a sufficiently low reactance compared with the circuit to act as efficient bypasses.

LOW TENSION CHOKE

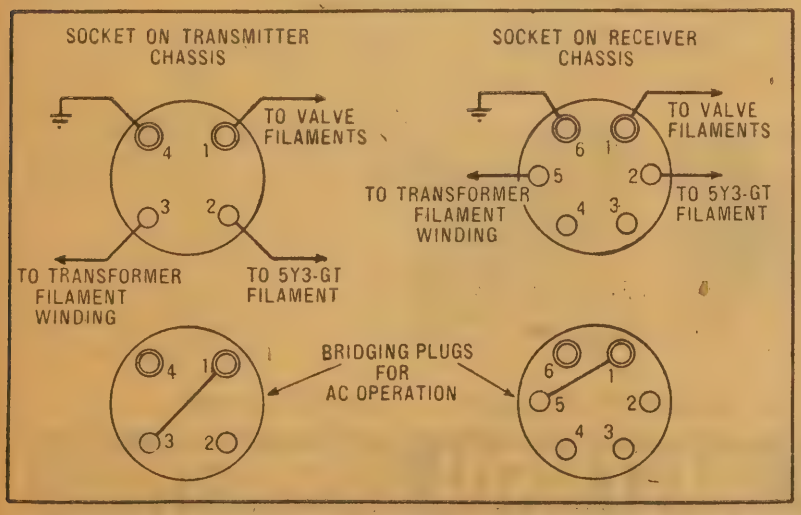
The low-tension circuit presents some problems. The choke has to carry a current of anything up to 4 amps, which means that it must have a low resistance if the voltage drop across it is not to be excessive. On the other hand, it must have sufficient inductance to be effective as a filter.

The two requirements are difficult

UNDERNEATH MAIN CHASSIS



At the top left are filter components associated with the receiver supply. All bypass condensers are returned to a common point on the chassis together with the heavy lead to the shield box and mounting plate. Filter components of the transmitter supply are to the right. Their placement is not critical.



The filament winding of the power transformer presents a very low resistance to the DC supply so that it must be disconnected for battery operation. Bridging plugs connect the filaments to the transformer when operating from AC.

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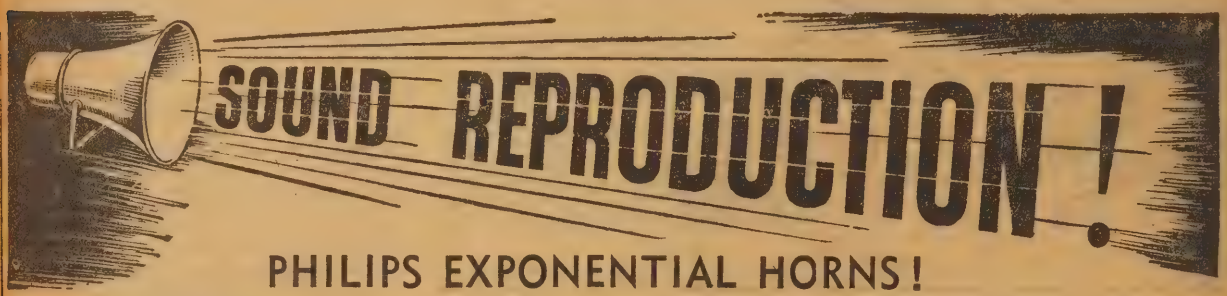

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to reconcile, plus the fact that a high value of capacitance is required as a bypass. The arrangement specified in our final design is a good compromise between efficiency and simplicity.

The receiver mentioned at the beginning requires 250V at 60 mA and the transmitter 250V or a little more at about 100 mA.

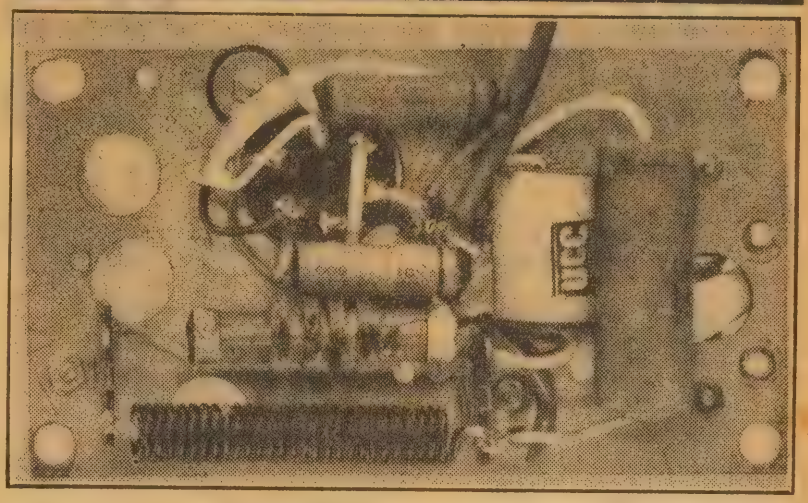
The primary supply is likely to be either a 6V or a 12V accumulator.

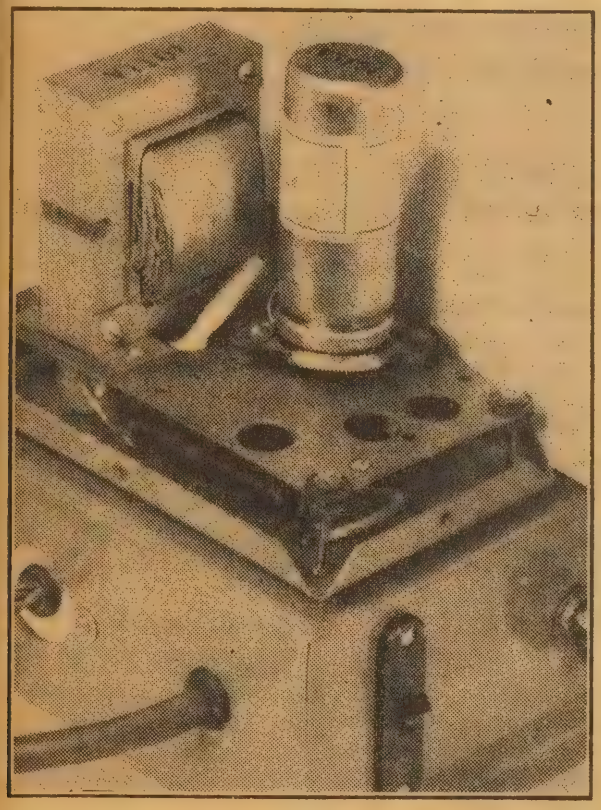
Vibrator supplies can also be made to operate from 24V or 32V mains, given suitable vibrators and transformers. However, in this case a disposals generator is well worth considering.

In the 6V case, the current-carrying capacity of a single vibrator is insufficient to supply the transmitter, although it will supply the receiver alone. A dual interrupter and a single large transformer will do the job with the disadvantage that a pair of 6X5-GT or 6X4 rectifiers will be required as a single rectifier has insufficient current-carrying capacity.

A more economical arrangement with regard to supply current and

CLOSE-UP OF RECEIVER SUPPLY





An underneath view of the mounting plate. The two bypass condensers and the buffer condensers are returned to a single point near the vibrator socket. A heavy lead connects this point with a single point on the shield box and thence to a single point on the main chassis.

☆

This top view of the mounting plate shows the flexible mounting for the vibrator and also the arrangement of fibre washers used to insulate the mounting plate from the support bolts. For mobile operation a heavier version of the same construction would be required.

probably less expensive is to use a pair of synchronous vibrators and a pair of transformers. The filament drain of the rectifiers is eliminated, and it is possible to switch off one of the vibrators when the receiver only is operating.

A 12V synchronous vibrator will handle sufficient current to supply the transmitter and, with a suitable transformer, the one supply will serve for both transmitter and receiver. Such a transformer may not always be available, in which case the same arrangement as suggested for 6V could be used.

Simply substitute the 12V equivalents of the 6V components shown on the circuit diagram.

As only one of the vibrators is in operation when receiving, it will be the only one requiring complete shielding and filtering.

In order to avoid introducing yet another design, we have used the standard Karset vibrator box. There are no electrolytic condensers or iron-cored chokes inside the box, so that a good deal of the space is unused. If you were starting from scratch to design a receiver to operate only from battery, this space could be used to make the overall equipment more compact.

The shield box is mounted on its supporting chassis by four long bolts. The bolts are insulated from the chassis but make contact with the bottom of the box. The mounting plate is also secured by the same long bolts but insulated from them.

In all, there are eight points at which the long bolts must be insulated. This can be done with rubber grommets of the type used for mounting gang condensers or you can achieve the required result with three fibre washers at each point. Two large fibre washers grip the metal under the nuts, while a small fibre washer prevents the bolt touching the side of the hole.

There is a certain amount of mechanical vibration from the vibrator cartridge transmitted to the outer case and, to minimise the effect of this, it is desirable to mount the vibrator socket on rubber. A pair of gang mounting grommets do an excellent job of absorbing the unwanted vibration. The unshielded vibrator should also be mounted on rubber.

As well as the transformer and vibrator, a pair of buffer condensers, two bypass condensers, a high-tension choke and a low-tension choke are mounted on the mounting plate. A pair of tag strips will be needed to support the ends of the chokes and all the condensers should be returned to the common point.

Before the plate is mounted permanently, the polarity of the output should be checked. Connect the battery between the outside end of the LT RFC and earth with the polarity you will finally be using and check the polarity of the output with a voltmeter. If it happens to be incorrect, simply reverse the transformer leads to the secondary contacts of the vibrator. Where synchronous vibrators are concerned, of course, the correct polarity must always be observed.

HOME-WOUND CHOKE

At this juncture, a few comments on the LT RFC are appropriate. The resistance of some of the chokes sold commercially for this purpose is too high for use with supplies where anything approaching the maximum output of the vibrator is required. We have found that results are better with home-wound self-supporting chokes.

In this particular case, the chokes consist of 30 turns of No. 14 wire closewound on a 3-8in. rod. After winding, the rod can be removed and the choke will be self supporting. Neither the gauge of the wire

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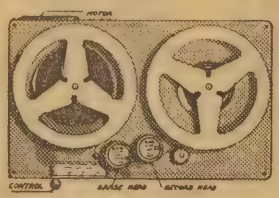

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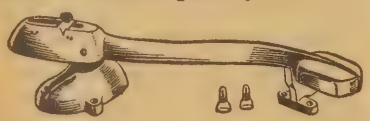

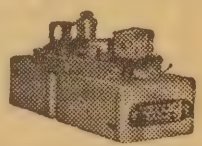

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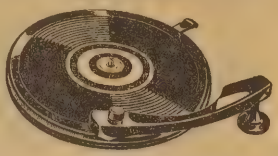

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nor the number of turns is critical.

The inductance is on the low side but sufficient to reduce the hash level in the low tension line to a barely significant figure. The last remaining hash can be removed by placing another section on the filter outside the shield box. The resistance of the choke is so low that it does not cause appreciable voltage drop.

The second unshielded supply is in general the same as the receiver supply except that no special care need be taken with the earth returns and a single section filter using one of the chokes described provides ample filtering for the low tension circuit. No high tension RF filtering is required.

TIME DELAY

The transmitter vibrator is brought into operation by switching the primary supply to the driving coil. The fact that the primary of the transformer is "alive" when the supply is switched to receive is not important because current cannot flow until the circuit is completed by the contacts of the vibrating reed. This technique allows a relatively low current carrying capacity switch to be used to make the changeover from transmit to receive.

An ordinary 3 x 3 rotary wafer switch was used in our case. In the extreme anti-clockwise position the output from the shielded supply is connected through to the receiver. To put the transmitter into operation the switch is turned through a neutral position to a clockwise position where the output of both supplies are connected in parallel and to the transmitter outlet plug. The driving coil of the unshielded supply is also energised in this position.

There is a special significance in the neutral position of the switch between the transmit and receive positions.

The electrolytic filter condensers in the transmitter and receiver respectively store energy and enable each unit to function for a short period after the supply is disconnected. When transmitting and receiving on the same frequency this may result in an unpleasant howl as the changeover is made. However, the neutral position of the switch introduces just sufficient delay to prevent this when the switch is manipulated in the normal way.

A spare contact on the switch enables energising current to be switched to an aerial relay if required.

An extra socket was mounted on the rear of the chassis of both the transmitter and the receiver and leads connected so that power from the vibrator supply could be applied to the input of the filter and also to the valve filaments. The filament power being DC it was necessary to arrange the wiring so that the winding of the transformer was disconnected when the vibrator supply is in use. Otherwise it would virtually short-circuit the low tension circuit.

A bridging plug which is placed in position when the equipment is operated from the AC mains is wired so that the transformer winding is connected when it is placed in position.

Just in case you are not too clear about this point we have included a separate diagram giving details of the wiring.

PORTABLE OR MOBILE

Our particular receiver operated perfectly with the wiring as shown but in some cases where noise limiters of this type are employed a certain amount of audio hash finds its way into the receiver due to coupling between the heater and cathode of the noise limiter diode.

The difficulty can be overcome by substituting a germanium diode for the diode valve or you can provide extra filtering for the noise limiter diode by means of an iron-cored low tension choke and a high capacity electrolytic condenser.

One of the iron-cored chokes of the type used for low tension filtering in vibrator receivers with directly heated valves and a 500 mfd 12V electro will do an excellent job. There will be some voltage drop across the choke but this will not affect the operation of the valve.

As mobile operation was not contemplated with the supply described here no special precautions were taken to guard against the ill-effects of vibration. For operation in a vehicle or a boat it would be desirable to use chassis made from heavy gauge metal. The supports for the mounting plate inside the shield box would have to be revised to carry the weight of the transformer under severe conditions.

Special sockets which incorporate heavy spring fingers to grip the base of the vibrator and thus remove any mechanical strain from the pins are usually incorporated in mobile equipment.

As we said earlier, these are matters that are difficult to discuss exhaustively in an article such as this. If we have given you a starting point, we will feel that we have done a good job.

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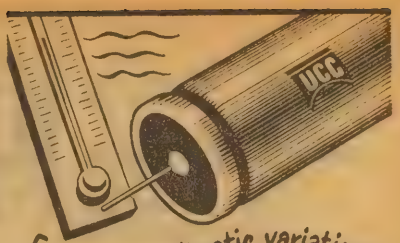

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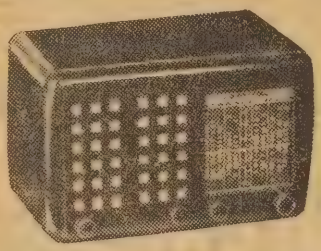

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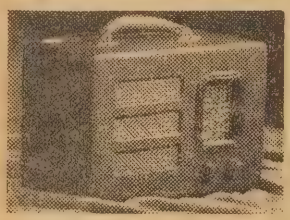

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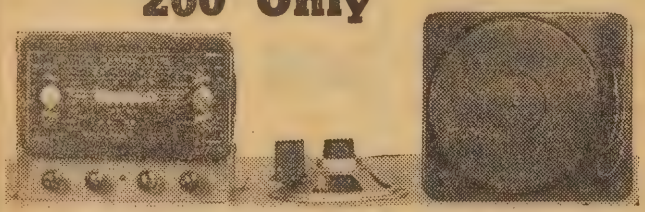

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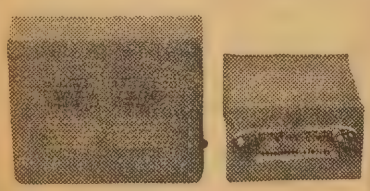

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APPROVED METHODS OF WIRING

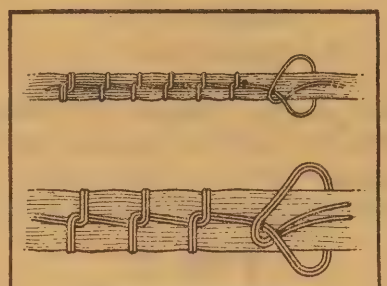
The old adage that warns that "a chain is no stronger than its weakest link" is nowhere truer than in the art of electronic wiring. Especially in today's advanced circuitry, where ruggedisation and reliability are the keynotes, proper wiring is a prerequisite. The art of proper wiring is discussed in this paper from the Engineering Department of the Aerovox Corporation.

WHERE the destination of a guided missile, the proper functioning of an airport blind landing radar equipment, or the final answer of an electronic computer may depend upon any one of thosands of tiny soldered connections, meticulous attention must be paid to such small details.

Even in the research and development field it is impossible to estimate how many important experiments may have failed because trivial circuit troubles masked the desired results.

And in less glamorous applications, such as the telephone industry and the radio and television manufacturing and servicing fields, the extra effort expended in producing dependable wiring has been found to pay dividends.

For these reasons, a working knowledge of the proper methods of producing a neat, dependable wiring job are required of every technician and engineer in the field of electronics.



SINGLE AND DOUBLE LACING STITCH

FIG. 3

This lay-out is usually arrived at by using a "mock-up" of the unit and parts and moving the parts around until a suitable arrangement is found.

The lay-out engineering should also provide for the use of the components which have the most suitable terminal arrangements for the particular job.

When all parts have been located the chassis holes required to mount them are drilled or punched.

For reliability, all parts except small capacitors, r.f. chokes, and resistors which are light enough to be self-supported on their wire leads must be securely fastened to the chassis. Strip-type terminal boards of the kind illustrated in Fig. 1 are useful for mounting such small components.

All other components must be securely attached to the chassis.

Where wires must go through metal panels or chassis, the holes should be suitably insulated. Rubber grommets are used for low voltage leads and ceramic feed-thru insulators are employed for high voltage circuits.

PROTECTS INSULATION

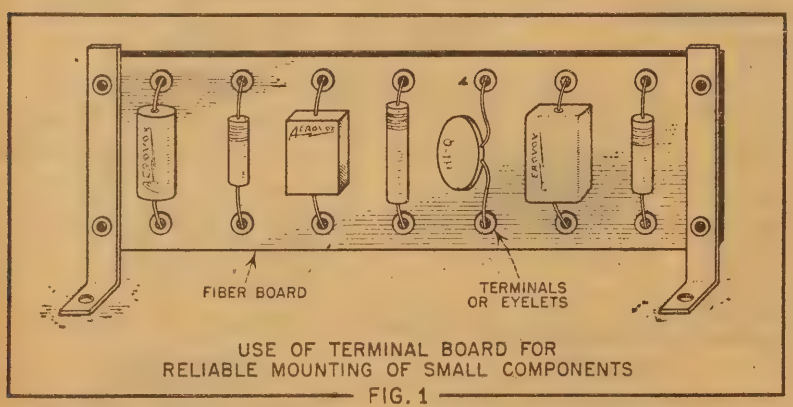
These precautions improve the reliability of the circuit by providing additional electrical insulation and prevent the rough edges of the hole from chafing the wire insulation.

When all circuit components are mounted, the unit is ready for wiring. If the unit is a one-of-a-kind wiring job, the wires may be run individually from one terminal to another, working from the wiring diagram.

The routing of the wires depends upon the nature of the circuit, the permanence of the wiring, and the allowable cost of the job.

In low-cost production wiring such as is found in broadcast receivers and television sets, direct point-to-point wiring is employed without much regard to appearance.

"In "custom" wired units, such as commercial communication equipment, telephone central office equipment, and quality audio equipment



USE OF TERMINAL BOARD FOR RELIABLE MOUNTING OF SMALL COMPONENTS

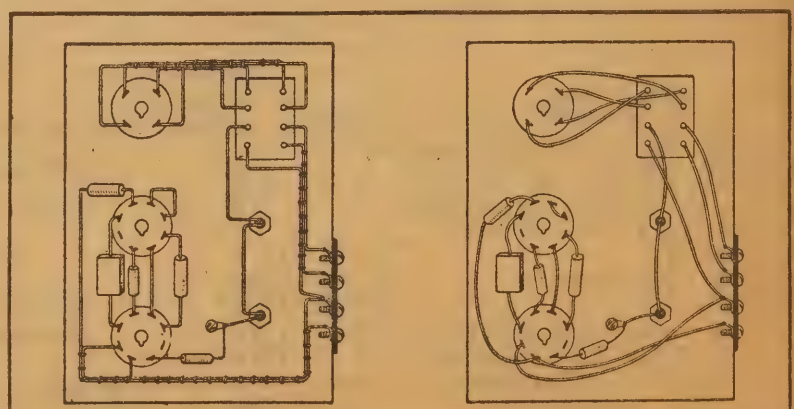
FIG. 1

The basic steps in wiring an electronic device are essentially the same regardless of whether the unit is an entire telephone central office or an ac/dc midget radio chassis. They are:

(a) Mounting the circuit components.
(b) Wiring and cabling.
(c) Connecting and lead dress.
(d) Visual inspection.
(e) Electrical inspection.

This article discusses these wiring operations in some detail, with special emphasis on (b) and (c).

The circuit layout should be engineered so that the components are located in the unit in positions which give short lead lengths for critical circuits, minimise the effects of hum fields radiated by chokes and transformers, and places temperature sensitive components in the most desirable environmental locations.



COMPARISON BETWEEN "CUSTOM" AND "STANDARD" WIRING

FIG. 2

t wiring and components are kept arallel to the sides of the chassis, so at the finished job presents a neat, ight-angled," appearance.

Where groups of wires take the me path, they are "cabled" or ced" together with waxed cord. The mparison between a chassis wired this manner and one in which int-to-point wiring is employed, is own in Fig. 2.

The proper use of the techniques of cing wire forms is a sure mark of e skilled wiring technician. The cing stitch illustrated in Fig. 3 is ndard throughout the Bell System d is simple and efficient.

Note that the parts of the lacing rd which run parallel to the wires nerge from under the part that encles the wires. This stitch is self-cking and will remain tight even hen the stitches on either side of it e cut.

EATER, STRONGER

Wire forms which run from one assis to another in a relay rack, well as within-the-chassis wiring, esent a much neater appearance and e stronger and more dependable if ced together in this manner to form compact cable.

Lacing also provides an index to e proper location of wires on a terinal strip or other circuit component "breaking-out" each wire at its oper location with a separate stitch, illustrated in Fig. 4. This allows e wires to be disconnected at any ture time and subsequently returned the proper terminals.

If more than one unit of a kind is be wired with cabled wires, or if especially neat job is desired, the oduction technique of using a orming board" is employed. This nsists of a large wooden board (Fig.) on which pegs or nails are laid ut to represent the shape the laced ire form must take.

Holes may also be drilled through e board at the location of each terinal to which the wires must be nnected.

IMILAR LAYOUT

The location of bends and terminals n the forming board are determined y carefully measuring the corresonding distances between the comonents in the chassis or between hassis. Then the individual wires re run between the proper points on ne board as indicated by the wiring iagram.

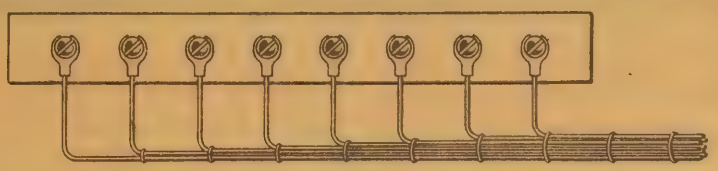
Unskilled labor can perform comlex wiring in this manner with few istakes, since the forming board can e clearly marked with numbers or olor coding to indicate the proper oints of attachment for each wire as ell as its proper routing and equence in the wiring operation.

The end of each wire is anchored n the board by wrapping it around nail or peg placed in a position epresenting the location of the terinal it will ultimately be connected). Enough excess should be allowed) permit stripping the insulation to ne proper length.

If holes are used in the board to fan" the wires through at the deired locations, the points of attachent will be on the back side of ne forming board.

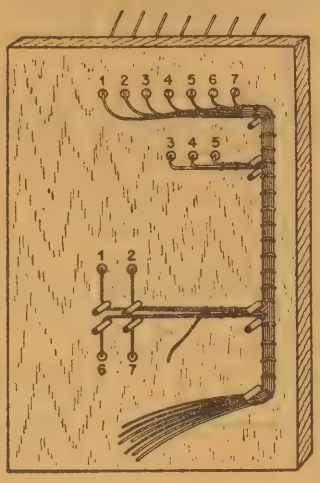
When all of the wires have been un on the forming board, they are abled together while still on the oard. Here they are usually more

CABLED WIRING IS NEATER



USE OF LACING STITCH AT TERMINAL STRIP

FIG 4



ILLUSTRATING USE OF CABLE FORMING BOARD

FIG. 5

accessible than in the chassis, making for a faster and neater job.

The wires may also be stripped of their insulation and readied for connecting after the cabling is complete so that they are held firmly in the positions they will assume in the chassis.

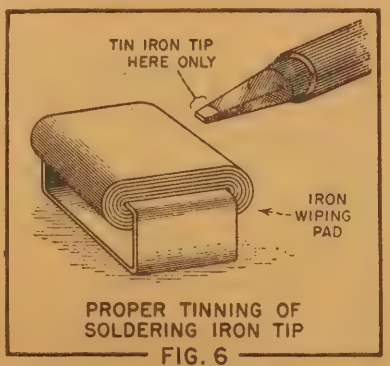
Connecting is the operation of electrically attaching the wires to the component terminals. The type of connection employed depends on the kind of terminals provided on the circuit components. These may be binding screws, soldering lugs, or directly soldered connections.

Soldering in some form is employed in all of these methods, but in none of them should the strength of the joint depend upon the strength of the solder. A firm mechanical attachment must be made between the wire and the terminal which is independent of the solder.

In the binding screw type of connection where soldering lugs are not used, the wire should be "tinned" with solder and then formed into a clockwise loop around the screw, so that it will tighten as the screw is tightened.

If soldering lugs are used, the grippers on the lug are crimped around the insulation on the wire for mechanical strength and the bared tip of the wire is soldered to the lug.

For directly soldered connections, the well-cleaned wire is wound once around the pre-tinned terminal for strength before soldering. Winding the wire around the terminal more than once usually makes subsequent removal of the connection difficult.



PROPER TINNING OF SOLDERING IRON TIP

FIG. 6

SOLDER AND IRON

The main secrets of producing good soldered connections are the preparation of the joint to be soldered and the maintenance of the soldering iron. Of course, the materials used play an important part also. Tinned wire of the "push-back" variety should be used where possible for ease of "skinning" and connecting.

The solder for all radio wiring should have a resin flux in the core and be a high tin content alloy.

If enamelled wire is used, the insulation must be stripped back and the enamel scraped off to expose the bare metal. Otherwise, a dependable soldered joint cannot be made.

The methods used to strip the insulation from hook-up wire depend upon the kind used. Most types are conveniently stripped by crushing the insulation with long nose pliers and dressing the frayed ends with the diagonals.

For the tougher types of insulation, such as the cellulose acetate braided kinds, a stripping tool is required. Care must be exercised to prevent "nicking" the wire during stripping and cleaning, as this frequently results in a broken connection later.

As mentioned above, when the wiring is done by running the wires between holes in a forming board, the wires can all be skinned at one time by reversing the board and removing the insulation to the right length.

To produce a clean, dependable soldered connection, the soldering iron must be of a type well adapted to the job and carefully maintained.

A versatile type of soldering iron tip for general connecting is shown

(Continued on Page 99)

A GUIDE TO TAPE DECK DESIGN

Having outlined, last month, the electrical and mechanical features required in a tape deck, our contributor now goes on to examine the half-track and full-track systems and suggests how a capstan drive may be devised from an ordinary phonograph motor.

By P. D. THOMAS—Part Two

THERE is no general rule for the direction of rotation of reels or the movement of tape. Each designer has his own ideas and it appears to be sheer chance if these ideas coincide with those of anybody else.

Often, of course, these matters are decided by factors outside the designer's control, but in starting from scratch there is usually some latitude and it is helpful to consider all the possibilities.

To start with the full reel of tape the manufacturers supply it with the emulsion side of the tape facing inwards, unless requested otherwise. It is logical to keep it like this to avoid having to rewind every new reel before it can be used, likewise any borrowed reels recorded on a different machine.

Some commercial recorders, mostly of American design, use the tape inside-out to give a more favorable mechanical layout. However, there is no point in doing it unless it is impossible to achieve a desired result in any other way.

Some recorders wind the tape on to the takeup reel with the emulsion facing out and some with it facing in. This makes little difference on a single-track recorder. If the practice of taking up with the emulsion out is adopted, it is easy to recognise a reel which has not been rewound if it should be removed from the recorder for any reason, and avoids the risk of starting to play a reel backwards.

With a capstan having no pressure roller, it is necessary to arrange for the side of the tape which will give the best traction to be in contact with the capstan. For any particular tape this depends entirely on the capstan material.

To discover which side is best, pull a short piece of tape around the capstan while keeping the other end taut. Try both sides in the same way; it will probably be found that one side "sticks" to the capstan much more readily than the other.

When a pressure roller is used it makes little difference which side of the tape faces the capstan. This is another argument in favor of using a pressure roller, since it is often necessary to use different types of tape, which might or might not "stick" to the capstan.

The two basic drive arrangements are shown in Fig. 5. In each case the capstan is shown as turning anti-clockwise. If it turned clockwise it would have to be on the other side of the tape.

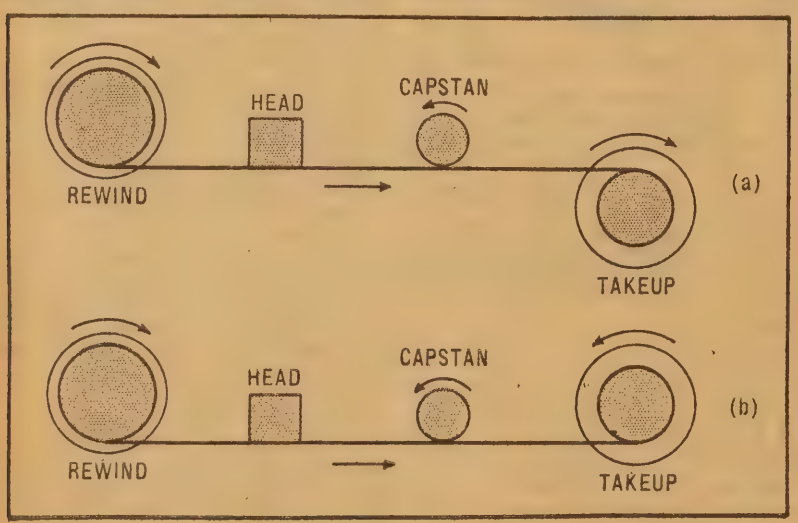


Figure 5: The two basic tape handling systems, with the reels travelling (when powered) in the same direction (a) or opposite directions (b). The latter arrangement is the more common, and is essential for half-track recording.

In Fig. 5a both reels turn, when powered, in the same direction, clockwise in this case. This takes up with the emulsion facing out. In Fig. 5b the reels wind in opposite directions, which gives a takeup with the emulsion facing in.

Note that direction of rotation always refers to the function of a motor or reel; thus, a clockwise rewind reel actually turns anti-clockwise during the forward run, since the tape is then being unwound from it.

For simplicity, no guides, pressure pads or rollers, &c., are shown in Fig. 5,

There are many possible variations of these two systems, but all layouts are variations of one or the other. Reversing both reel drives in each case gives four possible systems; from these, turning the tape over (emulsion-out to emulsion-in, and vice versa) gives eight, and so on.

Preferably, the rewind reel should be on the left and the takeup reel on the right of the operator, so that the tape moves from left to right.

REVERSING DIRECTION

Four-pole induction motors can be reversed, if the opposite rotation is required, by dismantling the casing and turning the field assembly upside down. This usually means that the leads to the field windings come out at the wrong point, but it is not difficult to find a new route for them, which must naturally clear the moving parts.

Reversing the connections of an AC motor does not, of course, reverse the direction of rotation.

At this stage it is worth while to consider in detail the different methods of using the width of the tape for recording.

Some of these are shown in Fig. 6 where in diagrams (a) to (e) the faces of the heads, with their gaps, are shown in contact with sections of tape. The arrows show the direction of tape travel in each case, and the emulsion side of the tape faces the reader.

Fig. 6 (a) is the simplest and most obvious system — "single-track" which records a track along the full width, or nearly the full width, of the tape.

Sketch (b) is exactly the same mechanically, but the head is narrower—perhaps 1-8th inch or 3-16th inch wide. This allows a smaller core, of more favorable shape, to be used, but gives less output on playback, other things being equal.

HALF-TRACK SYSTEM

Example (c) is a rather different case, much used commercially. This is correctly described as "half-track" recording. A narrow track is recorded along one half of the tape, then the two reels are changed over, aligning the other half with the head, and another recording can be made on this.

The playing time of a reel is thus doubled.

It is important to remember that the arrangement of reels shown in

Fig. 5b, or one of its variations, must be used for a half-track recorder. If this is not done, exchanging the reels will bring the backing of the tape against the face of the head. In other words, the reel drives of a half-track recorder must be in opposite directions.

The "Rule of the Road" for a half-track recording is illustrated in Fig. 6c. If the emulsion is regarded as the surface of a road, the head may be likened to a vehicle which keeps to the left as it moves along it. It is, of course, the tape which moves, but the relative movement is the same.

Fig. 6 (d) shows an improved version of the half-track recorder. This is correctly described as "double-track". The tape as recorded is identical and interchangeable with that recorded on a half-track machine, but, instead of changing over the reels to use the other track, the drive is reversed and another set of heads is switched into circuit to make use of the second track.

TWO ERASE HEADS

In some models, the erase heads are permanently mounted, one against each track, and the record/playback head is moved up or down mechanically. This is not ideal, since, apart from the mechanical complication, it is not easy to ensure that the head is always correctly positioned with no possibility of misalignment.

For comparison, a "twin-track" system is shown at (e). This uses two heads and two tracks, both quite independent but used simultaneously. This gives two parallel audio channels, which for example, are required for binaural recording.

This has nothing in common with the double-track tape mechanically, since the tape is driven in one direction only.

It is often useful to be able to run continuous loops of tape through the recorder but this can only be done if the drive is independent of the reels, eg, if both a pressure roller and pressure pads are used, or if some form of constant-tension braking is adopted.

A loop of any reasonable length can be made by cutting off the required length of tape and splicing the ends together. It will run through the recorder indefinitely without trouble once a clear path has been arranged for it.

An important use for a loop is in testing an amplifier system, to save the time which would be lost in rewinding in the ordinary way. This is particularly true if a series of short tests and adjustments have to be made, for example, to the frequency response or bias current.

The procedure here is to set the loop running, record a test signal, and then switch to playback. The test signal is immediately heard, and may be left repeating as often as necessary while the level, &c., is checked. A fresh signal may be recorded without any delay, merely by switching to "record" for the appropriate length of time and then back to "playback".

Paper tape can be marked on the back with ordinary ink, and serial numbers, running speeds and other information can be written conveniently at the beginning of each tape. This is a wise practice, and it avoids much exasperation in identifying different reels.

There is not much point in writing titles along the tape, since when it is used for some other material, the writing remains and may cause worse confusion. However, if each tape is numbered, it is easy to keep a simple index which can be revised whenever the tape is re-used, somewhat on these lines:

Tape No. 12; speed 7½. Program: Take It From Here. Tape No. 13, speed 15. Program: Dance music, Len Longhair's Band.

MARKING THE TAPE

Plastic tape will not take ordinary blue ink satisfactorily, but white ink as used in photographic work gives very legible results. Soft black pencil will also write on the coated side.

An excellent elaboration of this scheme is to use leaders of plain or colored paper or plastic, about a yard long, of the same size as the tape itself, at each end of the tape. These may be replaced if they become torn or damaged, and information may be written on them instead of on the tape.

With separate four-pole motors for rewind and takeup, the mechanical work is relatively easy; the only tricky part is the capstan unit, the design of which will depend upon

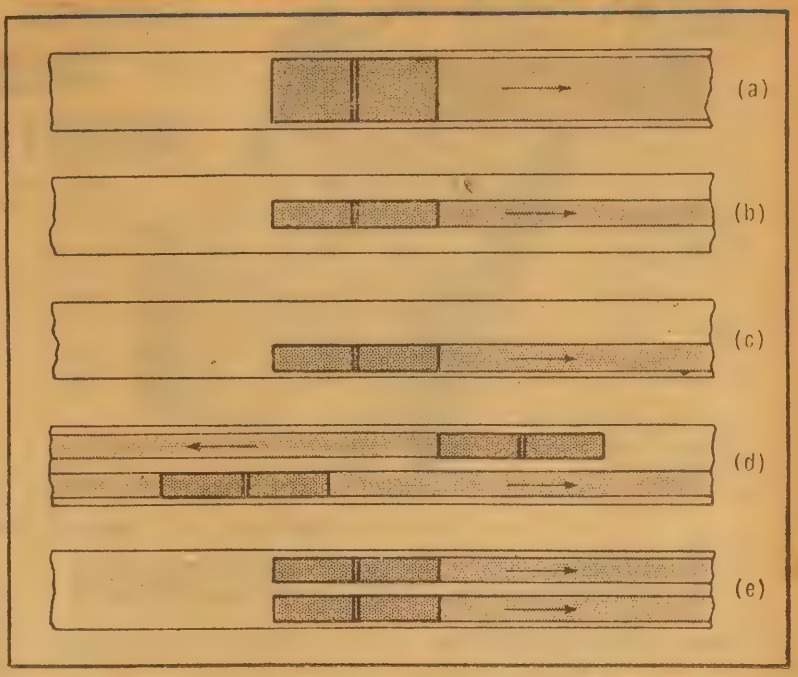


Figure 6: Illustrating the best known methods of recording on standard quarter-inch tape. Full-track (a) and half-track (c) are the most frequently used. As drawn, the emulsion side faces the reader.

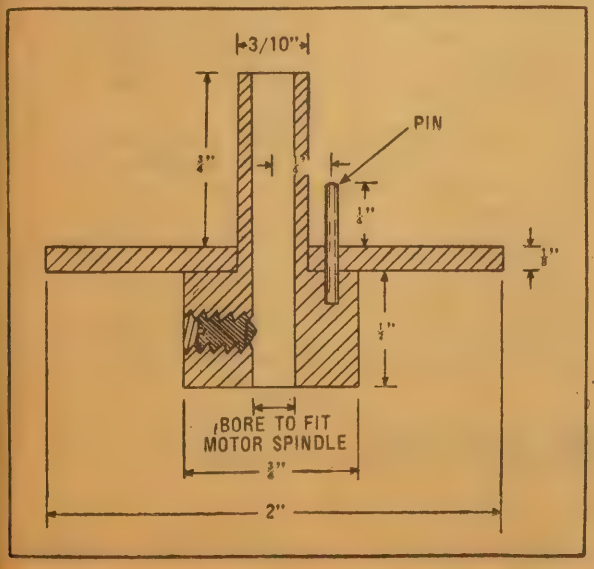


Figure 7: Typical dimensions for reel platforms suitable for locking to a ¼in spindle. The reels need not be locked in position unless it is necessary to use them vertically or operate quietly at high speeds. Some latitude is possible in the dimensions of the platform.

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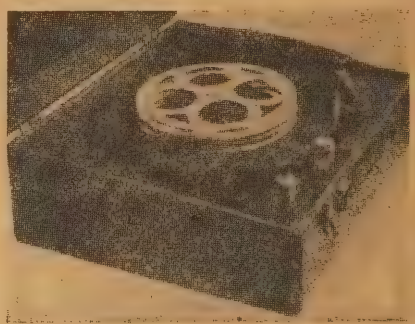

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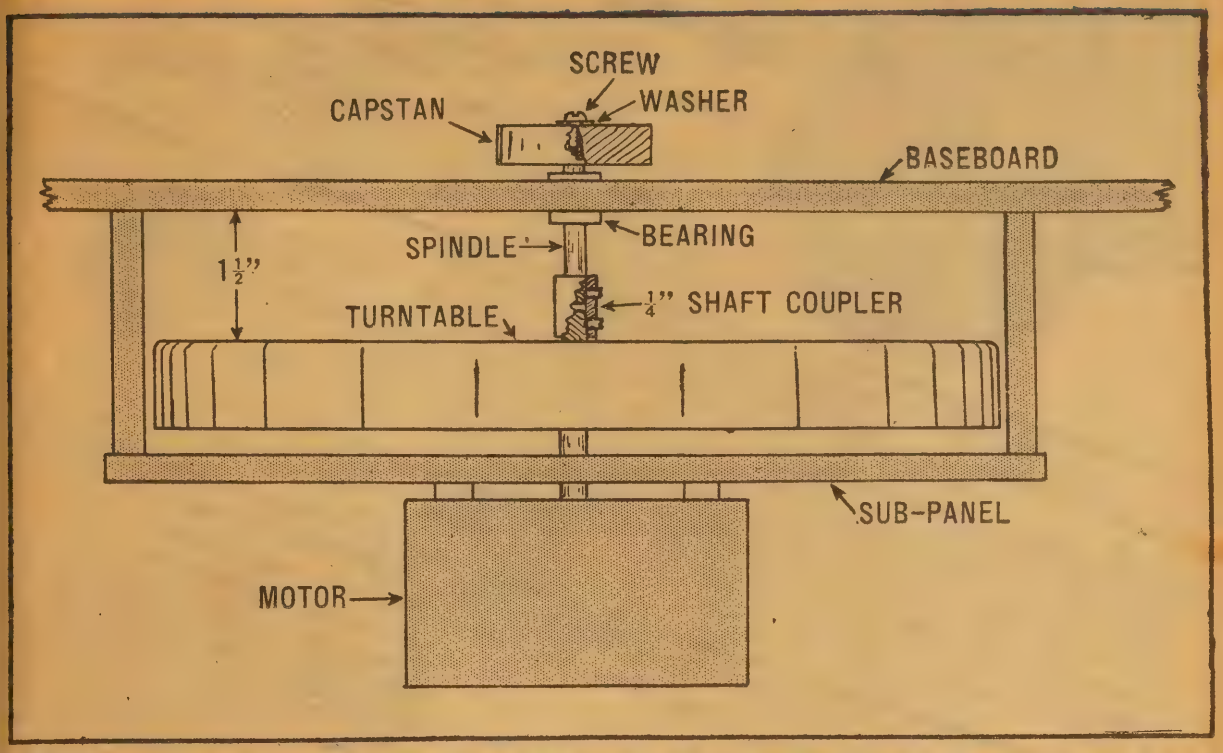

Figure 8: Using a standard 78 rpm phonograph motor as a capstan drive. With care, such a drive can give excellent results but it is generally more bulky and less flexible than specially designed drive systems.

the constructor's ambition, ability and means.

The reel motor units present little difficulty, and the same type is used for both rewind and takeup.

Each motor will require a reel platform such as that shown in Fig. 7. This is turned, preferably from brass, as this is easy to work, in two parts: (1) The centre bushing, which is fastened to the motor spindle with one or two grubscrews and (2) the platform itself. This is a 2in disc about 1-8in thick, which is a snug fit on the bushing. These parts are sweated together, and a hole to take a 1-16in pin is drilled through both as shown. Finally, the pin is sweated in place.

If the aim is a really smart job, the fittings can be cleaned up and chrome plated when they are finished. In any case it is a good idea to mount them in turn on one of the motors and polish them with a piece of fine emery cloth while the motor is running. This removes any rough edges and gives them a good finish.

SUB-PANEL

There is, naturally, no objection to turning the whole fitting out of one piece of metal, except that there will be a lot of waste if this is done.

A lathe does not form part of every experimenter's tool kit, but most light engineering firms will do the necessary turning for a few shillings plus the cost of the metal. The rest of the work can then be done with hand tools and a vice.

With such a large reel platform, it may not be easy to mount the motor directly on the baseboard. In this case, the motor should be mounted on a sub-panel of sheet metal or masonite, about 3in square. This can readily be fixed to the baseboard, through which a hole large enough to clear the platform will be cut.

Fig. 8 shows the essential details of one method of using a 78 rpm turntable and motor to drive a capstan. The motor unit is mounted on a sub-panel, perhaps 11in square, which is spaced below the main baseboard.

PART 3 of this article, describing the construction of a conventional tape drive system will appear in the next issue. Also in course of preparation is an article by the Technical Editor suggesting how you can make your own tape heads.

The materials required are: A ¼in steel spindle, about 2½in long; a bearing (either plain or, preferably, a ballrace with housing) to mount the spindle through the baseboard; a ¼in brass shaft coupler; a capstan turned from a suitable substance; a sub-panel of masonite or plywood; and the necessary screws and spacers.

Arrange four pillars or spacers to hold the sub-panel the correct distance below the baseboard, with screws top and bottom. Strips of wood could be used for this purpose, provided that they are accurately cut.

The hole in the baseboard for the spindle and bearing must be made next. From this, mark the turntable centre on the sub-panel and, if this is used as a guide to mark out the motor mounting holes, the turntable spindle will be correctly aligned below the hole in the baseboard.

If a ballrace is available, mount this next on the underside of the baseboard. Failing this, the bushing from an old volume control might be used, provided there is not too much play, but it must be kept well lubricated.

As the alignment of the bearing will probably not be perfect at the first attempt, allow a trifle of latitude in its mounting so that it can be finally adjusted to run freely after the motor and turntable have been mounted.

Ream or drill out one end of the shaft coupler so that it is a good fit on the top of the turntable spindle, and screw it in place. It may be necessary to file a small flat on this spindle which the grubscrew can grip. Check that the ¼in spindle will fit into the top end of the coupling, and that the top grubscrew will tighten on to it properly.

MUST BE TRUE

Now a certain amount of lathe work is necessary. The top end of the spindle must be tapered slightly for about ½in, and drilled and tapped for a 1-8in Whitworth screw, or a similar thread such as 4 BA.

At the same time the capstan can be turned, with a taper in the centre hole to fit the end of the spindle. When the screw is tightened, as in fig 8, the capstan should be tight and true on the spindle.

(Continued on Page 103)

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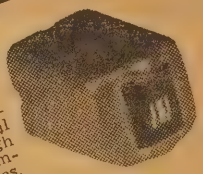

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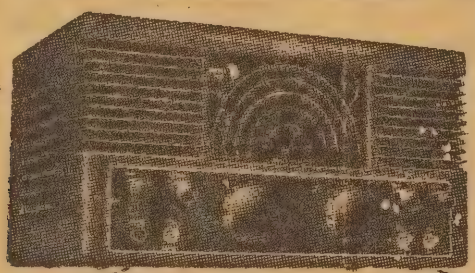

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You may find it hard to imagine that a communications receiver of first class British construction could be the lowest priced top-performance receiver on the market! But it's a fact! What's more the Eddystone "740" is specially designed to meet the exacting requirements of "hams" with a host of important features:

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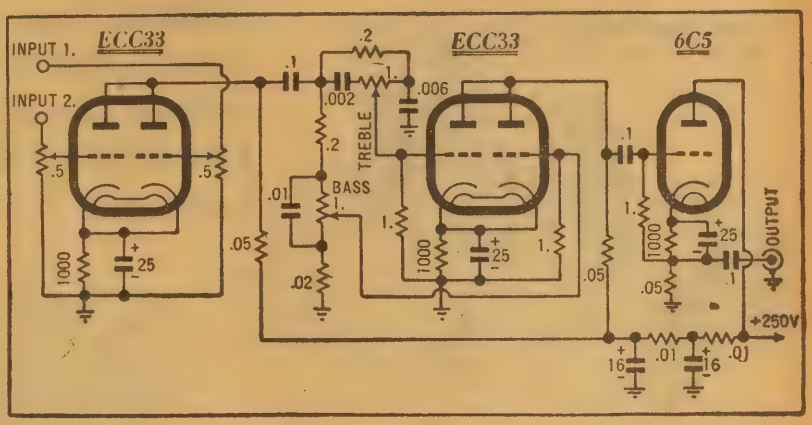
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

MIXING PREAMP. WITH BASS AND TREBLE CONTROLS

Here are details of a mixing circuit which, when used ahead of a main amplifier, will enable you to handle two separate channels, whether microphones, pick-ups or a combination of both.



OUR contributor is Mr. B. Hepworth, c/- Guild of Undergraduates, University of Western Australia, Crawley, WA.

The unit was built on a 10in by 3½in by 1½in chassis with a 10in by 4in front panel and fitted into a small polished plywood box.

The requirement on which the design was based was for twin turntables equipped with crystal pick-ups from which background music was faded in and out at appropriate times during presentation of plays. The idea can be carried to one microphone and a pick-up or a pair of microphone channels.

Suitable compensation to take care of disc recording characteristics was included in the pick-up input loading. On this matter we would refer you to the November, 1952, issue of R & H.

The two inputs are fed to separate grids of the first stage, whose anodes, and cathodes are paralleled and the actual mixing is achieved in the common anode circuit. The output from this stage is fed into two separate frequency-conscious networks in which a potentiometer provides variable control on bass or treble as the case may be.

Some variation in the value of the .01 mfd bass "boost" capacitor may be required to obtain most suitable acoustical results for background music in amateur dramatic stage work. For instance, the required degree of maximum boost will depend somewhat on the level of output at the speakers and the distance of the audience from the speakers.

The bass and treble outputs are taken to separate grids of another twin-triode valve having its cathode and anodes tied together. The amplified bass and treble components are mixed in the common anode circuit of this stage and fed to the grid of cathode-follower output stage. Almost any triode may be used in this output stage.

The high tension and heater supply will, in most cases, be taken from the main amplifier. Our contributor has used two decoupling sections between the high tension line and the two twin-triode stages. He says that the hum level is very low and was negligible for all uses to which he put the unit.

HEATER CIRCUIT

You will need to check the heater circuit of the main amplifier to see whether it is best raised above chassis potential to reduce hum injection into grid circuits or whether one side or the centre-tap of the winding/s is simply earthed.

The output of the preamplifier is taken from across the cathode load of the output stage.

The gain control of the main amplifier would normally be set so that there is sufficient level control on each of the two channels without making the channel gain adjustment too critical. You will find that a gain setting for an empty hall will need advancing quite considerably when the hall is filled by an audience. The type of construction of the hall and the position selected for the speakers will have a bearing on the required output level.

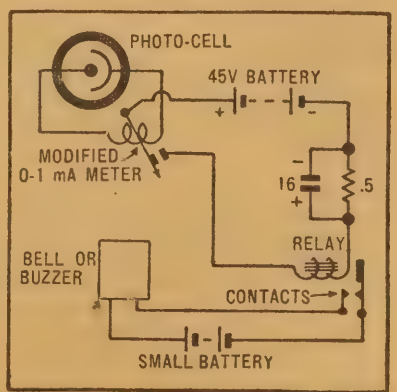
PHOTO-CELL ALARM SYSTEM

The idea for this alarm came from Mr. G. B. Wolfe, Box 56, Bombala, NSW. It is essentially an "approach" indicator as it produces only one warning ring from a bell for each cycle of operation of the system.

MR. WOLFE used an old exposure meter photo-electric cell. He found that the light from a window caused sufficient current to flow in the cell to operate an old 0-1 mA meter movement. This meter movement was modified to carry a couple of small contacts, one being on the meter needle, so that it formed a very sensitive relay.

When the light rays falling upon the selenium type cell are interrupted, the current through the 0-1 mA meter falls off and the attached contacts close to complete a series circuit consisting of a 45-volt battery, a 16 mfd electrolytic capacitor and the winding of a disposals type relay. The initial surge of charging current into the 16 mfd capacitor momentarily closes the disposals type relay which connects a warning bell to its battery. The .5 megohm resistor across the 16 mfd discharges it ready to operate again.

It is merely the initial surge of charging current into the 16 mfd which closes the disposals relay.



The disposals relay was the type usually found on a disposals telephone panel. If another type is used which differs greatly in DC resistance, some variation of the capacitor value may be required.

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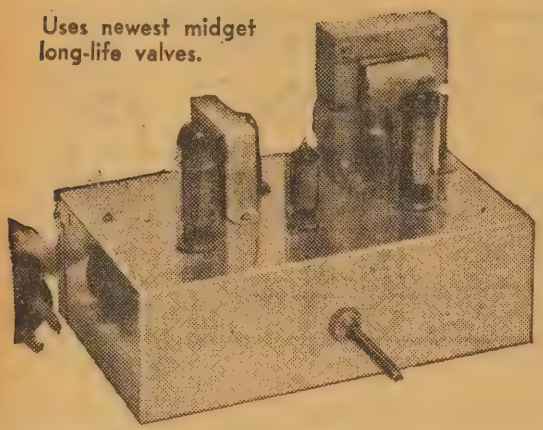
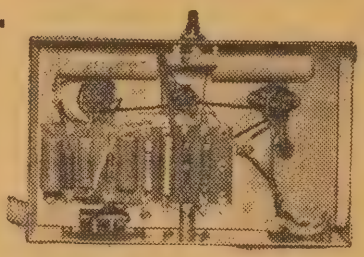


Photographs of the COLRAD amplifier as built by one of our customers—an ordinary home constructor—whose time for the complete job, using our kit of parts, was a few minutes over three hours.

You can do the same with this new COLRAD amplifier kit. Every required hole is already punched in the chassis. The small components mount on tag-strip supplied. Only tools needed are screwdriver, pliers and soldering iron.

a GOOD, inexpensive 4½ watt A.C. AMPLIFIER at a price you can afford. Available as an absolutely COMPLETE KIT of parts or ready built and tested for sound.



The kit of parts is complete to the last detail, including screws and nuts, wire, 9-point tag-strip, and even a coil of solder. Price packed and posted (Part No. 3H1).

£9-15-0

post free

Circuit Blueprint, Instructions and Parts List Free with Part Nos. 3H1 and 3H2.

ORDER NOW FOR QUICK DELIVERY

If you prefer to buy this amplifier completely wired, tested and ready for use, the cost is very little more. Ample volume for the average home. Price, packed and posted

★ For record reproduction you will need motor and turntable, crystal pick-up and loudspeaker. Attractive prices for these items are quoted below.

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Post Free (Part No. 3H2)

Be sure to specify KIT or WIRED UNIT

Auxiliary Parts suitable for use with amplifier.

* BSR 3-speed Gramo-Motor and Turntable. 230 or 110 VAC, **£3/19/6.** (Part No. 3H3).
Postage: Vic., 3/8; NSW, Tas., SA, 6/-; WA, Q, NT, 8/4.

* BSR 3-speed Gramo-Motor MU14 and Turntable, knob speed change 78—45—33 RPM. **£7.** (Part No. 3H4.)
Postage: Vic., 3/8; NSW, Tas., SA, 6/-; WA, Q, NT, 8/4.

* BSR MONARCH 3-speed 10-record changer. **£26.** (Part No. 3H5.)
We send Freight forward, Passenger Rail, or Air.

* BSR GU4 record player, automatic stop, 3-speed, turn-over crystal and sapphire, head knob-speed change. **£14/14/-.** (Part No. 3H6.)
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* Garrard Type T, 3-speed motor and pickup. **£16/17/6.** (Part No. 3H7.)
We send Freight forward, Passenger Rail, or Air.

* Metal cabinet to suit amplifier, black crackle finish, louvred ends, rounded corners, front panel, and volume indicator plate, 11in x 7in x 5½in. Price **29/6.** (Part No. 3H8.)
Postage: Vic., 3/8; NSW, Tas., SA, 6/-; WA, Q, NT, 8/4.

* Acos crystal pickup GP30, sapphire, turn-over head, for 78 and LP. **£4/19/6.** (Part No. 3H9.)
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* Acos hi-fi crystal pickup GP20, sapphire with Plug-in 78, or LP head. **£5/6/-.** (Part No. 3H10.)
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Extra Head, LP or 78, **£2/19/9.**
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***For descriptive details of any part marked with an asterisk please send stamped (3½d) self-addressed envelope and mention part numbers. Or use our Fast Quote Service.**

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CALIBRATING YOUR OSCILLATOR

As promised last month, here are some suggestions for those who have completed the audio test oscillator and wish to carry out the job of calibration. The procedure you follow will depend on the facilities you have available, but fortunately there are a number of possible frequency standards.

NO matter what you use as a frequency standard, a very important part of the job is to make up a scale and pointer. A suitable size for the scale in this case is 5½in x 3¾in, and it should be of a heavy white card which is capable of taking ink.

A pair of 270 degree concentric arcs and a suitable border around the edge of the scale can be put on with a draughtsman's ink compass and pen before starting the calibration, likewise the positions of the small bolts used to secure the scale to the case of the instrument.

Hold the scale on the front panel and mark the positions of the holes through the card with a scriber, after which they can be drilled the required size. At this stage you could also prepare a piece of thin celluloid exactly the same size as the scale. It can be placed over the scale afterwards and serve to protect it from fingermarks.

MAKING A POINTER

You will also need a pointer about 2¼in radius. It can be made from scrap celluloid or perspex about 1-16in thick and secured to the back of the large control knob. If you have a set of taps and some corresponding small bolts probably the best way to do this is to tap the holes into the back of the knob.

The job of calibration is made very much easier if you make up a special pointer for the purpose. Start by making two identical pointers, both with a line ruled down the centre. Then cut one of the pointers down the centre line and remove one half. A pencil line can then be ruled against the straight edge of this pointer to mark the calibration position. The time taken to make the pointer will be saved many times, and a more accurate job will result.

After calibration with light pencil lines, the card can be removed, the calibration marks inked in and the lettering added. If you can do a neat job by hand all to the good, but a lettering guide of an appropriate size makes it much easier.

POSSIBLE "STANDARDS"

There are a number of possible standards you can use for calibration. Possibly you can compare your instrument with another audio signal generator known to be accurate. The output of both instruments can be fed into an amplifier and tuned for "zero beat".

Over the middle register there should be no difficulty in detecting the setting at which both instruments are on exactly the same frequency. However, at very high and very low frequencies there will be difficulties due to a falling off in the response of the amplifier and the speakers, as well as your own ear.

A cathode ray oscilloscope provides a more satisfactory means of comparing the frequency of the two audio sources. Connect one to the input of the vertical amplifier and the other to the input of the horizontal amplifier. (It will first be necessary to disconnect the linear sweep oscillator from the latter.)

Most likely the pattern seen on the screen will take the form of a rectangle or a large number of moving lines filling in the space of a rectangle. Adjust the gain controls of the oscilloscope and/or attenuators of the oscillators until the rectangle approximates a square.

If you vary the frequency of either you will observe a change in the character of the pattern seen on the screen. For a start set the standard to, say, 200 cycles. Then vary the dial of the new oscillator over the middle portion of the lower range. If you tune carefully you will find a setting at which the pattern becomes a stationary circle (or something like one) which indicates that both oscillators are on the same frequency.

You will probably be able to cover the greater portion of the frequency range in this way and it doesn't take very long when you are properly set up to do the job. At the higher frequencies it may not be possible to obtain a stationary circle on the screen, but up to 20 Kc at least there should be no difficulty in observing the circle flash on the screen when you are at the correct calibration point. It may be necessary to rock the control backwards and forwards by a small amount.

OTHER PATTERNS

The procedure outlined is the one you would normally use if the standard covers the full frequency range, but there are simple patterns which indicate frequency ratios of 2 to 1, 3 to 1, &c., and these may be useful if the standard covers only portion of the range. You can check the appearance of the patterns at known frequency ratios. The 2 to 1 pattern looks something like a bow tie, for example, with one particular phase relationship. Many textbooks contain illustrations of these "Lissajou Figures".

The 50 cycle power mains is an excellent source of check points toward the low frequency end of the range. You will be able to check 25, 50, 100, 150 and 200 fairly easily, but higher than this the patterns become too complicated and difficult to identify. Many oscilloscopes have a 50 cycle terminal on the front panel, but if not, you can easily pick it up from a filament winding.

An excellent source of known frequencies is a set of test records. They are available to cover frequencies between 25 cycles and 20 Kc, but even if you can't get the full range you may be able to make do by observing the patterns just mentioned. A fairly good pickup is necessary in order to reproduce the full range in any case. The output is likely to be masked by scratch at the high end of the range and there may be some difficulty in keeping the stylus in the groove at the lower frequencies.

Of course, the turntable must run smoothly at exactly 78 rpm and it will be necessary to check its speed with a stroboscope. A good governor-type spring motor is often more satisfactory than an electric motor in this application.

In Sydney, at least, the automatic telephone system provides some useful check points. Simply by dialing FA06 you can get a tone at 1600 cps which can be compared with the oscillator aurally as suggested earlier. If you dial your own number you will hear an engaged signal which is 400 cps. The harmonics at 800 and 1200 cps are prominent in this signal, due to the characteristics of the telephone circuit.

BROADCAST STATIONS

The national broadcasting stations make frequency checks one night each week, usually half an hour after the regular closing time. They broadcast frequencies between 35 cps and 10,000 cps. Before each tone is transmitted, the frequency is announced and the tone is left on for about 20 seconds, which is sufficient time to get a check if you already have an idea of the calibration positions.

Finally, a properly-tuned piano can be used as a standard frequency source. If the piano is tuned to the usual physical pitch, middle C is 256 cps. The C's below middle C are 128, 64, 32 and 16 cps in that order. The C's above middle C are 512, 1024, 2048 and 4096 cps.

The frequency of any note on the piano can be worked out by multiplying the frequency of the nearest C below the note by the appropriate factor given below. If you wish to work out every note on the piano a slide-rule or a book of log tables would save time.

The factors are as follows: — C: 1.000; C sharp: 1.059; D: 1.123; D sharp: 1.189; E: 1.260; F: 1.335; F sharp: 1.141; G: 1.498; G sharp: 1.587; A: 1.682; A sharp: 1.782; B: 1.888; and C: 2.000.

The accuracy with which the instrument can be calibrated warrants working out the frequencies to three significant figures.

It hardly need be said that before doing an accurate job of calibration you should make sure that the frequency determining circuits are permanent and secure. For example, make sure that the particular potentiometer you have does not have any backlash between the shaft and the wiper arm. Just in case any troubles of this nature do develop it is often a good idea to use the instrument roughly calibrated for a little while before attempting an accurate job.

FOR BETTER S.W. (SHORT WAVE)

RESULTS INSIST UPON

"Q PLUS" DUAL WAVE

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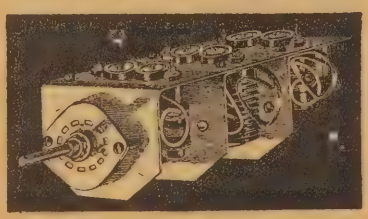
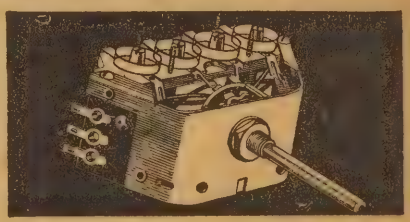
HERE ARE THE REASONS WHY

1. Only Lo-Loss polystyrene Formers are used.
2. Special "Tuning wand" spherical particle High-Frequency Carbonyl powders are exclusively used — this retains the "Q" of an air cored S.W. coil yet allows fulll inductive tracking.
3. Each unit being small allows a minumum of stray capacities and leakage shus making available the fulll sensitivity for your use.
4. Units are designed for wanted connverters and thus gives of their best when used correctly.
5. Grid current details and circuit hints were included in advertising in January and June, 1953 R & H — Conversion gain is maximum when Ig. is optimum.

NOTE THE EXCELLENT VALUE TOO!



RETAIL PRICE
TYPE
DWR 135/4d
TYPE
DW 72/6d
(Inc. 20% S. Tax)



Type DWR available as follows:
DWR4/16—6J8, 6A8 etc. 16-50M & 535-1630 Kc only.
DWR5/13—ECH35, X61M, 6AE8, 6AN7.13-42M and B/C.
DWR5/16—As above but 16-50M S.W. coverage.
DWR6/16—1R5, 1A7 etc. 16-50M S.W. and B/C.
DWR7/13—6BE6, 6SA7, B/C & 13-42M.
DWR7/16—Ditto B/C and 16-50M.

Type DW available as follows:
DW4—6J8, 6A8 etc. B/C & 16-50M.
DW5—ECH35, X61M, 6AE8, 6AN7. B/C & 16-50M.
DW6—1R5. B/C & 16-50M.
DW7—6BE6/6SA7. B/C & 16-50M.

OTHER BANDS TO ORDER

TRADE REVIEWS AND RELEASES

NEW ROLA 12-O HAS SPECIAL CONE

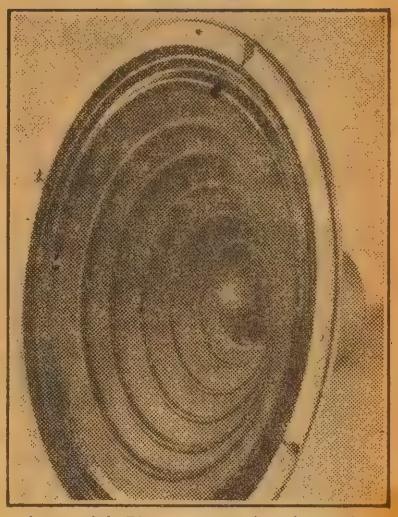
Despite the emphasis on wide range reproducers accentuated by micro-groove record, there is a strong case for a speaker having a higher-than-average response without reaching into the extreme top register.

FULL-RANGE speakers demand a high standard of performance from pick-ups, records or radio, otherwise the presence of distortion will be shown up more unpleasantly than on restricted-range speakers.

Rola have provided for the wide-range market in the production of the 12-OX, and can supply a larger model—the 12-UX—where higher power is needed. But for more average use, the 12-O is now available with a special F29 cone, featuring a treated surround which appreciably smoothes out the bass response.

The top response continues without appreciable variation to about 8 Kc, after which there is a gradual but pronounced drop in output.

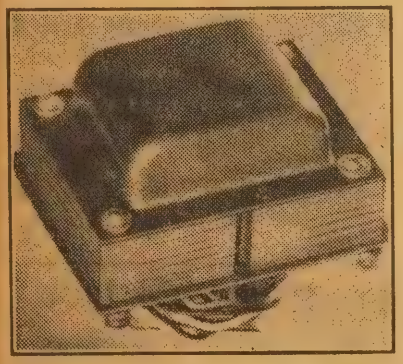
On test, this overall smoothness was borne out in practice. The cone resonance of our sample was 70 cycles, but when loaded did not show up unduly on an amplifier with adequate feedback. Useful response continues down to about 50 cycles, and there are no unreasonable peaks throughout the range. For general use on the better type of equipment the 12-O with special F29 cone sounds a very good speaker, and holds a solid position in the medium-priced field.



A special F29 cone is fitted to this model Rola 12-0 speaker. Treatment of the surround gives a smoother bass response. The speaker is an excellent performer.

FERGUSON DUAL-MOUNT TRANSFORMER

A horizontal mounting power transformer which will fit any of the standard hole centres has been produced by Ferguson, primarily for replacement to substitute for old types which have failed.



A Ferguson dual-mounting transformer with removable mounting plate to fit old-style transformer centres. No extra charge.

THE transformer is fitted with an adaptor plate, for which a patent has been applied, making it suitable for 3 x 3½ inch mounting hole centres.

By removing the plate, the transformer will fit 2½ x 3 1-8 centres. Thus the one transformer will serve as a replacement for two different set types merely by removing or retaining the plate.

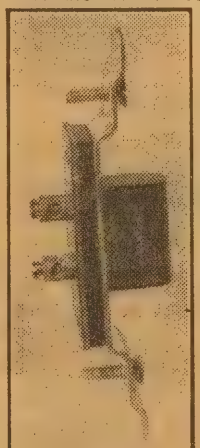
The Dual Mounting transformer will be identified with its present type number with the addition of the letter F. Thus, PF 151F will indicate the standard PF 151 type adapted for flat mounting.

The price of both types will be the same. It is pointed out that the 200-volt primary tapping will eventually be omitted from both upright and horizontal types.

The Dual Mounting transformers will be available in a full range, from 285v 60 mill to 385 v 100 mill types.

LUMOLITE NEON INDICATOR

FOR many years it has been standard practice in flush plate combinations to use a 15-watt lamp behind a red bezel which is fitted to the bakelite escutcheon plate. Due to lack of ventilation, which causes excessive temperature rise, the lamp life is extremely short and, in addition, the moulded lamp housing, the lamp socket and the escutcheon plate itself are frequently buckled or rendered unserviceable.



A Lumolite Neon indicator consumes virtually no current and fits behind a standard escutcheon plate.

In response to many requests from the trade for a product to overcome these problems so often encountered, the Lumolite FP3 neon flush plate was developed, embodying the following important features:

(1) Consumes only 1/10 watt.
(2) Complete absence of heat.
(3) Almost indefinite life.
(4) Easily installed without specialised knowledge.
(5) Designed to eliminate red bezel, filament lamp and screw base.
(6) Costs no more than old-type installation.

Australian and export agents are W. J. McLellan and Co. Pty., Ltd., 126 Sussex St., Sydney.

EXTENSION SPEAKERS

AN extremely useful booklet just issued by Rola is Extension Loudspeakers, priced 1/-. Sooner or later everyone has cause to consider adding an extra loudspeaker, either in the home or in an office or factory. As with most things, there is a right and a wrong way to go about it, and one can be faced with some tricky problems when volume levels are to be controlled, for instance, without some guidance.

In a simple, comprehensive fashion, this booklet deals first of all with the simpler cases such as would occur in the home, and, secondly, with more complex installations where many speakers are required for group connection.

Useful formula and connecting diagrams are included to allow you to calculate the various impedances to suit your case, plus information on the best type of speaker to use, and how to mount it. This booklet should be on the shelf or file of every enthusiast and service man, and is nicely presented and illustrated.

IN our recent review of the Connoisseur Super-lightweight Pick-up, the price of the heads was given as £3/5/-, including tax. In fact, 13/- tax should be added to this figure.

NEW H.F. RECEIVERS AND TRANSMITTERS

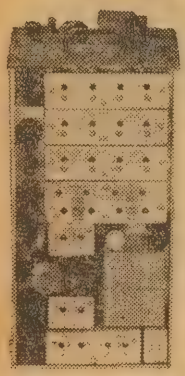
COMPLETE WITH FOURTEEN 6.3V VALVES AND PLUGS, etc.
IDEAL FOR 144 MEG. BAND

NEW IN CARTON **£4/17/6** GENUINE BARGAIN

PHOTOSTAT OF CIRCUIT 7/6 EXTRA

R.C.A. TYPE A.R.B. RECEIVERS

Made in America.



CONTINUOUS COVERAGE 195KC TO 9050KC in 4 SWITCHED BANDS. Valve line up 12F7 R.F., 12SA7 converter, two 12SF7 I.F. amplifiers, 12SF7 det. and 12A6 output.

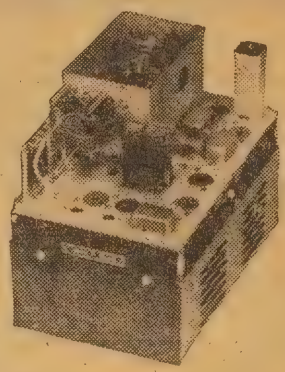
£19/10/-

PLUS FREIGHT

Receiver complete with genemotor for 24V operation but readily adaptable for 12V or 32V. D.C. operation or 240V A.C. with external power supply.
PHOTOSTAT OF CIRCUIT SUPPLIED WITH EACH RECEIVER

Converted to 240 Volt A.C. operation with power supply and speaker.

£29/17/6 FREIGHT EXTRA



H.F. Oscillator

Frequency approx. 200 m/c Adaptable to the 144 m/c Band. Complete with 2-7193 Valves.

Type "B" 12/6
POST FREE

19/6
PLUS FREIGHT
BY PASS. TRAIN ONLY

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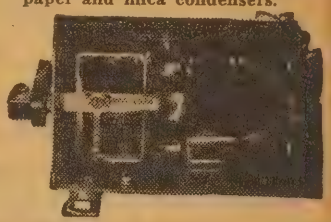
CONTAINED IN ALUMINIUM CASE

H.F. Oscillator, frequency approx. 200 m/c, complete with 10 high insulation octal sockets, two 7193 valves, I.F. transformer, 45 insulated carbon resistors, mainly 2 watt, 24 paper and mica condensers.



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Range 0-14 Amps Scale Size — 4in Dia. Brand new.
Price, each,
45/-
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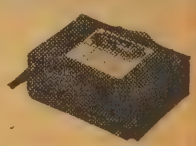

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Nylex hook-up wire 10/- .010 in 100 yard coils, each coil consisting of five 20 yard lengths in 5 different colours.

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OFF THE RECORD — NEWS & REVIEWS

Despite gloomy predictions early in the piece, microgroove records have not proved themselves nearly as fragile or susceptible to damage as one might expect, although their extreme flexibility and immunity to breakage aren't stressed as much as formerly. Reasonable care is all one needs in their treatment.

By JOHN MOYLE

A RECENT letter from a reader asks me to comment on microgroove fragility as he hesitates to spend money on equipment and records if scratches and crackles are to ruin his investment. He didn't express himself quite as briefly as that, but he meant it all the same!

I hesitate in a way to make definite pronouncements in this matter because I think it will readily be recognised that fewer things are liable to abuse than phonograph records.

There are, of course, the dyed-in-the-wool purists who remove each disc under controlled conditions as a ritual, watchful of dust, fingers on the edges, envelopes sprung open, turntables carefully brushed before use, and immediate replacement after playing in a cabinet with a closed lid.

In the hands of such people, it wouldn't matter much what material records were made of—they would have a good life.

RECORDS EVERYWHERE

On the other hand we have those who enter a musical evening with a happy-go-lucky gusto in which, before long, records are sprayed all over the place—on the table, on the carpet, piled in heaps, handed around the assembled guests, and left lying about without covering.

No records will survive this treatment without showing wear and tear.

Any assessment of a record material's ability to withstand use must depend almost entirely on the manner in which it is treated. Personally I do believe in being careful with discs. I don't handle their surfaces if I can help it, even the 78 types. I always spring open the covers when withdrawing or replacing them, and I always clean the turntable before using, and return the records to their covers as soon as I have done with them. Sparing use of a preparation such as "clendisc" will remove occasional dirt.

MORE DAMAGING

The main objection to LP records in this matter of damage is that one decent scratch will affect up to 20 minutes or so of playing time, whereas with 78 records only a few minutes would be spoiled. There is no answer to this, other than to be a bit more careful.

With featherweight pick-ups, I haven't found an occasional swipe with the stylus does as much damage as one might think. Such handling is quite unpardonable, of course, because with less frequent changing of sides, and no need to hurry over the job, carelessness deserves its own reward, and sooner or later will get it. But I have LP records with a multitude of fine scratches and abrasions on the surfaces through hard wear (not at my hands!) but which play quite well. The high degree of de-emphasis with which they must be played helps no end in suppressing light scratches of this kind.

I would say therefore that it's too pessimistic an attitude to shy away from LP records because you are afraid of scratching them. After all the remedy is in your own hands. If you are careless, any records will die the death. You can drop an LP record with little fear of it cracking, although its not unbreakable literally. But its surface isn't as hard as the shellac and obviously the grooves are finer.

One most important thing to watch is that dirt of any kind does not get into the record covers. One piece of fair-sized grit will slice its way over a complete surface as you move the disc in or out. Some records I keep in an inner covering of folded tissue paper. It's an idea for almost perfect protection against abrasion in storage.

And, of course, no one in his senses ever stores records flat in heaps. Always place them on edge, preferably with the open side to the rear to reduce dust gathering, and supported in a vertical position. Never allow records to stand at an angle, to invite warpage.

WARPED RECORDS

Warped LP records are a problem because they must on no account be warmed. They can be improved by storing under moderate weight, but modern LPs I have found virtually free from warps. After all you can inspect before you buy.

Now for some discs I've heard through the month.

HINDEMITH—Symphony, Mathis der Maler—played by the NBC Symphony Orchestra conducted by Guido Cantelli. HMV BLP 1010.

A remarkable record both in performance and in substance. There is quite a story to the substance, well told in the annotations. The material is taken from Hindemith's opera Mathis der Maler dealing with the painter's mental conflicts between his work and his relations with his fellow men. It is therefore based on a program which is important in appreciating the history and application of the music.

The work is extremely interesting technically, for beneath the harmonic surface, which may still sound strange to some, there is a clear and sound contrapuntal structure and considerable orchestral ingenuity. For these and other reasons, it is never dull, even if its intensely dramatic treatment would allow it to be so. It is, in fact, a significant piece of work in the history of recent music.

The recording is exceptionally good, not so much for its wide range, but for general balance and internal clarity. Confusion and muddiness would be fatal to this work, but I thought those pitfalls had been well avoided. It has great weight to sustain the big brass chords and yet it plays cleanly. The surface, too, is good.

In summary, a record to hear.

BARBER OF SEVILLE

ROSSINI—William Tell and Barber of Seville Overtures. BIZET — Carmen Prelude. Played by the Austrian Symphony Orchestra and the Paris Opera Orchestra. (Westminster.)

This 10in record of popular-classical music is bound to be well received, although the general standard I did not think up to previous Westminster issues. The Paris orchestra records the best and plays the best. There is uncertainty in the Austrian group, and a fluffed entry in the "Barber" will, I fear, be noticed by some. Still it's a lot of acceptable music on one record.

SCHUBERT — String Quartet in D Minor (Death and the Maiden) played by the Vienna Konzerthaus Quartet. (Westminster WL5052.)

This quartet is one of Schubert's greatest works — probably one of half-a-dozen which alone would grade him with the greatest composers. Its name comes from the use in the second movement of the theme from his song Death and the Maiden. This, and the fact that he had recently been ill and depressed leads to the belief expressed in the annotations that the quartet has a "death" motif—defiance of death, acceptance of death, dances with death.

BACKGROUND ONLY

That's all right if one likes this kind of programing, but to me it is a sure path to missing the full significance of the music. There probably was some brooding and unhappiness in Schubert's mind when he wrote it, but I do not believe he meant such moods to be interpretated so literally or so sweepingly.

My advice to anyone playing the work for the first time is to regard this conception as little more than a vague background which comes to all of us now and then, but which colors more than guides. In any case it is so mixed with other emotions that to separate and apply it in our own minds is to confine our appreciation unbearably.

Some of Schubert's works are not remarkable for their technical skill, but this quartet is shot through with genius in ideas and in treatment. It requires a rare blend of imagination and proportion to do it justice.

The second and key movement is probably the best example of this, in which much depends on the first violin's exercise of both these things.

It requires, too, the finest blending of instruments, and of performers, again with special reference to the slow movement, where there is scarcely a note that can be played without complete cohesion with its fellows. There are whole passages where the four instruments must sound literally as one.

The playing of the Vienna Konzerthaus Quartet is remarkably fine in all these things, and is as good as anything I have heard on records. There are no concessions to the laying it on process of which I had something to say last month. This music must be played with restraint or it will cloy, it requires precision and proportion or it may at times become ragged. I doubt whether there is an awkward moment anywhere in this performance.

The recording and instrumental balance are extremely good. As with most European recordings, I imagine the recording curve has decidedly more pre-emphasis than normal, and the disc will play best with some extra top cut. My main criticism is that the last half of the first side isn't too clean, particularly near the finish, and this may show up on high-grade equipment. Strangely enough, the second side is most consistent throughout.

Surface noise is quite low, and a big improvement on some earlier Westminster releases.

LISZT CONCERTO

LISZT—Concerto in E Flat, Concerto in A Major, for piano and orchestra, played by EDITH FARNADI and the Vienna State Opera Orchestra conducted by Hermann Scherchen. (Westminster WL5168.)

This is another disc about which Westminster can be happy, for most things have gone right with it. It's a pretty good test for the art of record making, too, for these are brilliant show pieces, in which the possible difficulties of recording engineers not yet born or thought of were far from the composer's mind.

Both concerti are well known, and frequently played at concerts and over the air. They are frank show pieces, brilliant to hear and tuneful when appropriate. They are not far removed from the progenitors of film symphonic music, except that they are somewhat better than we are accustomed to hear. But the shape and ingredients are there.

The Vienna Orchestra needs little commendation at this stage, but the brilliance and resource of the pianiste does call for a special word. She has weight and precision unusual for the fair sex, and although the piano is more remote from the microphone than is customary, her work sounds well balanced and impressive.

The recording is commendably clean even for wide range. The frequency limit is ample—perhaps a little light in the bass but not seriously so. The surface is quiet, and only in one or two spots near the centres does the piano develop any whiskers.

RESPIGHI—Fountains of Rome, Pines of Rome played by the Vienna State Opera Orchestra. (Westminster. WL5167).

These are two remarkable works by a master of orchestral color. They are frankly programmatic — sound pictures of specific fountains and pines in and around Rome.

Respighi's genius is in the vivid portrayal of each, and we don't need much imagination to estimate their general character. No one could miss, for instance, the sudden burst of brilliant sound breaking through the brass fanfare heralding the turning on of the water in the Triton Fountain, and the bell-like dripping into suddenly-created pools. Or the general sun-drenched atmosphere and gusts of wind which shatter the drops into spray.

The fountains in order are the Valla Giulia at Dawn, the Triton Fountain in the Morning, the Fountain of Trevi at Midday and the Villa Medici Fountain at Sunset.

The Pines of Rome gives similar treatment to its own subject.

This, I think, is one of Westminster's best releases, and illustrates the sound, competent musicianship of the Vienna musicians, who have featured in so many of these discs. Technically it is first rate, and only a purist would turn a doubtful ear here and there where the pressure may have been a little too great for something along the line.

The surface, again, is particularly quiet—possibly the best I have heard from Westminster to date.

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SHORT-WAVE NOTES BY ART CUSHEN

RADIO HOLLANDIA USES 60 METRES

Hollandia, Dutch New Guinea, has added an additional transmitter in the 60 metre band, which has been trying out two frequencies.

RADIO HOLLANDIA, Dutch New Guinea, which has been operating for the past two years on 7126 kilocycles, with 500 watts, has been reported by Jim Paris and George Hughes in Adelaide as operating on 5046 kc. This broadcast was heard here during Hollandia's evening transmission from 7.30—10.00 pm, but has recently moved to 4865 kc, a frequency less suitable for reception due to severe side band interference from Tokio AFRS on 4860 kc.

Hollandia is operated by the Dutch Government information service for listeners in Dutch New Guinea, and the transmitter and other installations are still being improved. The staff is small, and the record library is only 1000 recordings. Hollandia is recognised by the frequent use of the chimes of Big Ben which are broadcast at 7.30 and 8.30 pm. News in Dutch is generally presented at 8 pm.

TO MOVE TO BIAK

The transmitter is soon to be moved from Hollandia to Biak, when the facilities will include a new 5000 watt transmitter, and it is hoped to operate from this location before the end of the year, reports Radio Australia.

The complete schedule is now 7.30—10 pm daily, except Thursday, 7 pm—10 pm; Saturday 7.30—10.30 pm. On Saturday an afternoon transmission, 1.00—2.00 is broadcast and on Sunday is carried noon—2 pm. Hollandia time is half an hour behind Australian Eastern Time.

Reports are welcomed by the station, which verifies with a fine card. The address is "Radio Omreop, Nieuw Guinea, Hollandia" and this is also the slogan of the station.

NEW COLOMBIAN

HJKH SUTATENZA, Colombia, has been reported widely throughout Australasia on 5070 kc, from sign on at 9 pm or later. The station's strong signal was first reported by Jim Paris in Adelaide, and was followed for several weeks without any positive identification. Jack Corbett, Brisbane, reported the identification to us, and the station has moved from 5060 kc.

HJKH uses the slogan "Radio Cultural, Escuelas Radiodifonicos Colombia"' and relays the B/C station HJKI. The station operates from 9 pm but as it seems to be still in experimental state, the station has been heard opening as late as 10 pm. Sign on is with chimes, and a devotional service follows, while at 10 pm the chimes of a clock striking seven is broadcast. After 10 pm signals fade out but strength is the best on the 60-metre band at 9.30 pm.

NOUMEA ON 3375 KC

NOUMEA, New Caledonia, has added a second transmitter, this one in the 85-metre band, on 3375 Kc, and is heard at good strength in the evening transmission 5 pm—8.30 pm. Noumea has followed the example of Suva in using a lower frequency, and reception is free from any interference.

Noumea also operates on 6035 Kc but suffers interference on this frequency. Noumea has two transmitters, one of 1000 watts which uses 6035 Kc, being of French construction and coupled to a doublet antenna, while the second transmitter is of 500 watts, with a vertical antenna, this latter transmitter has been operating on B/C, 1500 kc and it is presumed that it is now using the 3375 Kc frequency.

Broadcasts are in French throughout, the complete schedule is 10 am—noon; 5 pm—8.30 pm, while the slogan is "La Voix de la France dans le Pacifique — Noumea".

NOTES for the next issue close at 212 Earn Street, Invercargill, N.Z. on September 5th. All times listed are Australian Eastern Time.

FROM THE MAILBAG

FORCES BROADCASTING STATION, Tripoli, verified with a card and letter, which stated that our report was the first from the Southern Hemisphere. The transmitter, a B/C 610, operates with 250 watts to a dipole antenna. The station commander (Hedley Chambers) in a covering letter states that our report caused no end of a stir at the station. Tripoli is now using 4965 kc, being formerly on 4785 Kc, and the station has been heard closing at 7 am. OAX6H, TACNA, Peru, which recently has been testing to 3 pm on 942 KC, verified Jack Corbett, Brisbane, stating the frequency change was made to clear the interference being received from XEWW 9500 kc. OAX6H "Estacion Radio Tacna" verified with a letter and photo of the transmitter.

RADIO CRYSTAL

RADIO CRYSTAL in San Jose, Costa Rica, operates stations TIHB on 690 Kc and TIHBG on 6006 Kc. TIHBG has been in operation since March this year and uses 1500 watts, while the broadcast band station, with 3000 watts commenced operations in 1945. Radio Crystal states in a verification letter from Roger Barahona Gomez, that our report was the first from New Zealand, though others have been received from Canada, USA, South America and Europe. The address for TIHBG is Apartado 341, San Jose.

LISTEN FOR THESE DX STATIONS

Kc.	Call and Location	Times Heard (A.E.S.T.)
3330	Singapore, Malaya.	Closes 1.30 am.
3960	London, England.	News 7.45 am.
3980	ZJV3, Suva, Fiji.	3.30-8.00 pm (New Call)
4860	Hollandia, New Guinea.	7.30-10.00 pm.
6010	CJCX, Sydney. N.S. Canada.	News 7.45 pm.
11725	Tokio, Japan. JOA6	News 5.00 pm.
11850	Delhi, India.	News broadcast 12.30 pm.
11895	Karachi, Pakistan.	English news 12.30 pm.
15135	Tokio, Japan. JOB6	To Australia 7.00 pm.

FLASHES FROM EVERYWHERE

RADIO MALAYA, Singapore, broadcasts the English Network programs on a new frequency, 3330Kc, as well as 4825Kc. Singapore has dropped the use of 7200Kc in favor of the lower frequency, signals are good, though not as strong as on 4825Kc. The station was first noted closing at 1.30 am, and now has been heard to 1.30 am on weekdays and 2.00 am on Sunday.

INDONESIAN signals are being well received for the DXer who is prepared to do some early morning listening, and on Sunday they are mainly heard with extended schedule. At 1.00 am, strong signals are heard from YDD (3205), YDM (3270), YDA (3390), YDP (4930), YDM2 (5030) and YDJ (5060). Two stations, YDD (3205) and YDB2 (4910) have been noted broadcasting all night on Saturday, through to sign off at 7.00 am Sunday morning with Indonesian programs.

THE VOICE OF GERMANY, operating from Cologne, has been using 5980Kc in the North American service to 2.30 pm, when reception has been received at fair strength, and better than the other outlet on 11795Kc. The 5980Kc channel is also used to relay the European service of Nordwest Rundfunk. The "Deutsche Welle" transmissions from Cologne, at present are carried to North America 11.30 am-2.30 pm on 5980, 11795Kc, to Far East, 15275Kc 8.30-11.30 pm, to Near East 12.30-3.30 am on 11795Kc, to Africa 4.00-7.00 am on 11795Kc. Reports are appreciated, and verification is in the form of a card showing Cologne Cathedral in the background, fronted by a map of Germany. The address is "Deutsche Welle", Wallrafplatz 5, Cologne, Germany, and reports of reception, for at least 15 minutes' listening, will be verified.

LOWER POWERED JAPANESE RELAYS have been noted on 6005Kc and 3975Kc at 3.00 pm with broadcasts of the Japanese Home Service. Our logs show these stations to be used for relay work, and using only 300W. Three stations are assigned to each frequency, JKA20 Tokio, JKD20 Nagoya, JKQ20 Kumamoto on 3975Kc, and JKU21 Sapporo, JKD21 Nagoya, JKP21 Kumamoto on 6005Kc. CJCX SYDNEY, NOVA SCOTIA, the Easternmost station in North America, a rare signal on 6010Kc, has been heard at fair strength at 7.45 pm with news, and a devotional service at 8.00 pm. CJCX is mixed with the Japanese transmitter on 6005Kc and VOA on 6015Kc.

HAITI'S latest addition to the short-wave field is station V4A, which has been testing on 6090Kc, and is now operating on 9485Kc, to sign off at 10.30 am. Reports are requested, to P.O. Box 94, Port-au-Prince, Haiti, while the slogan is "Radio Commerce", reports the Australian DX session. CUBA'S new time announcement station, COCW, on 6320Kc, which has been operating for many years as a commercial station, is now broadcasting under a new style, using the slogan "Radio Reporte de la Hora Havana." Time and commercial announcements are given frequently between chimes, and the station has been heard opening at 9.30 pm, and again in the afternoons, closing at 3.00 pm. The station follows very closely the pattern of ZYZ20 in Rio de Janiero, which we reported hearing earlier this year. COMMERCIAL SERVICE, of Radio Ceylon, is being received by Rex Gillett in Adelaide on a new 49 metre frequency, 6006Kc, from sign on at 10.30 pm.

FORCES BROADCASTING SERVICE, McKinnon Rd., Kenya, verified Jack Corbett, Brisbane, with a card showing power as 250 watts. The station lists the address as PO Box 4040, Nairobi, while the schedule was not stated. Other FBS stations listed were No. 1 Tripoli, No. 2 Nairobi, No 4 Cyprus, No 5 Benghazi and FBS Headquarters Fayid.

THE HAM BANDS WITH BILL MOORE

Amateur Radio often provides a hobby and means of communication for the blind and incapacitated. There are many such cases throughout the world, and licensing authorities in many countries provide every assistance to incapacitated persons to qualify as operators of amateur radio stations.

THE entry of Ray Williams, ZL2AQG, Hawkes Bay, New Zealand, constitutes a story of considerable human interest, the hobby affording Ray a means of communication with the outside world that would normally be denied him.

In 1931, Ray, while playing football, was injured, causing complete paralysis, and since then has been confined to bed and unable to move. Some few years ago, a visitor, Paul Barcham, asked Ray whether he was interested in radio, and after some discussion it was decided he should be tutored, with the idea of obtaining an amateur licence.

George Strudd, of Napier, with the aid of a blackboard, coached Ray in the intricacies of the radio technique. The officials of the Post and Telegraph Department were fully co-operative and he was successful in an official oral examination, no mean feat for one incapacitated and over 40 years of age. The local gang gathered together and built suitable equipment, plus ingenious control gear, and on July 19, 1952, ZL2AQG was first on the air on 3.5 mc/s.

Since that day, Ray has made many friends in New Zealand and Australia, via amateur radio. His first contact with this country was with Crieff Retallick, VK2XO, of Raleigh. From his cheerful conversation, one would gather no idea of his infirmity.

OPERATES ON 3624Kc

He operates on 3624Kc normally, his frequency is fixed by necessity, and stations contacting him should net carefully on his transmission to eliminate any need to tune his receiver. His wife operates the transmitter. In view of the above, stations operating around the frequency could possibly keep clear when ZL2AQG is on the air. The microphone is strapped to the bed and as a high frequency permit has been obtained Ray will now be able to operate on 14 mc/s. The locals intend to erect a beam and arrange equipment to allow transmission on these frequencies.

Amateur radio has provided an interest for many incapacitated persons, an opportunity to talk with people in a variety of positions and locations.

John Proctor, G3FJP, is another badly handicapped amateur. In addition to being blind, he has no hands, and operates his equipment with the stumps of his wrists. John is active on 3.5 mc/s, using a crystal controlled transmitter specially constructed for him by local amateurs. The receiver, an Eddystone 640, was supplied by the makers, Stratton and Co. Ltd.

GROWTH OF WIA

All WIA workers and amateurs in general are gratified to see the growth in strength and effectiveness as a representative body of the Wireless Institute of Australia since the end of the war.

The increase in the number of licences issued annually has tapered off in the last three years and this has been reflected to some degree in Institute membership figures. Responsible for the growth in prestige is the valuable work done by the various executive in the Federal and State fields on a voluntary basis.

The Institute since its inception has been guided by the members to one main objective, to represent in all fields as fully and effectively as possible, the Australian radio amateur. The organisation centres Federally around the Federal Executive, which since the war has been located in Melbourne. Federal councillors, the Federal representatives of each State, together with Federal Executive, meet at specified times, generally annually. Councillors, under directions from State Divisions, formulate policy of a nation wide and international nature.

State Divisional Councils are elected annually to administer and co-ordinate the varied State activities. This includes the running of AOCP classes for intending amateurs, lectures, WIA broadcasts, QSL Bureaus, Country Zones, Field Days, State and Country conventions, plus the other phases of operation that go to make up a successful Division.

In Victoria, the Division accepts the added responsibility of publishing the WIA's official organ, "Amateur Radio".

The WIA has an important function to perform, a strong institute strong in membership and effectively supported, can best serve the amateur. If you are not a member, you should consider joining, to assist the Institute to assist you, and gain the most technically and socially from the hobby.

CONTEST ACTIVITIES

THE New Zealand Memorial Contest for 1953 was conducted by the NZART on July 18 and 19. Similar to the VK Remembrance Day contest, it is held annually in memory of radio amateurs who gave their lives in World War II. The contest was extremely well supported judging from activity on the 80-metre band.

Rules vary from the Australian event and amateurs throughout the world can participate. The contest, too, is divided into several sections including low power, open (CW and Telephony), and beginners' CW events.

Besides a number of Australian stations, VR2CT, ZK2AA, VR2CG and W7MSB were heard assisting participants on 80 metres.

Operating hours were limited and two sessions were conducted, late afternoon and evening on Saturday and Sunday.

The 1926 May issue of the Wireless Institute Gazette published by the NSW Division of the WIA, carried some interesting details of the 1926 Trans-Pacific tests. Comparison with contests as they are today shows the development in this sphere of activity in recent years.

The 1926 tests were run over two full weeks and most of the preparatory work was performed by the then Honorary Federal Secretary of the WIA, the late Ross A. Hull, later to become Editor of QST. These tests were organised with the co-operation of the American Radio Relay League.

The main objects of the test were:—

(1) To demonstrate to the world the advance stage of amateur radio communication at that period.

(2) To discover the most reliable and effective amateur station in each of the States of Australia and USA.

(3) To establish definitely the hours during which reliable communication could be maintained across the Pacific.

(4) To observe the relative effectiveness of the 20 and 40 metre bands for trans-Pacific working and to stimulate interest on wavelengths as low as 5 metres.

FOUR SECTIONS

The tests were divided into four sections: The first of these to discover the most reliable and effective stations. Test messages of 500 words had to be transmitted to an American station during the contest period, and a similar message had to be received from across the Pacific. Full log details of the message handling were required and factors to be considered in judging this section were: The total time taken to transmit the test message, the method and speed of keying and the power and location of the station participating. Official observation stations checked on the general operation of contestants. A special "A" grade amateur station certificate was awarded by the WIA to stations satisfying the test requirements.

The second section of the test was to decide the effectiveness of 20 and 40 metres for trans-Pacific working. Two 24-hour test periods were set aside for continuous operation and propagation conditions were observed. Copies of the logs were sent to the ARRL for information.

Section three allowed two four-hour periods in the evening for transmissions in the order of 5 metres and stations in both W and VK were also invited to report on any local transmissions heard.

The final section was a low power event, operation permitted on any three nights of the test and results were judged on a miles per watt basis. Special prizes were awarded to the various winners.

These series of tests show that today we conduct similar events. Perhaps they are more streamlined and we do have the advantage of knowing something of propagation conditions and a few extra watts!

FROM THE ARRL

ANNUAL ARRL board meetings are generally noted for the decisions of import made on matters affecting amateur radio in the US. This year's meeting was no exception. Resolutions concerning civil defence nets, special awards for amateurs, TVI problems and the like were discussed and voted upon.

According to reports this meeting was significant also for what it did not do! No suggestion was tabled affecting amateur radio regulatory matters.

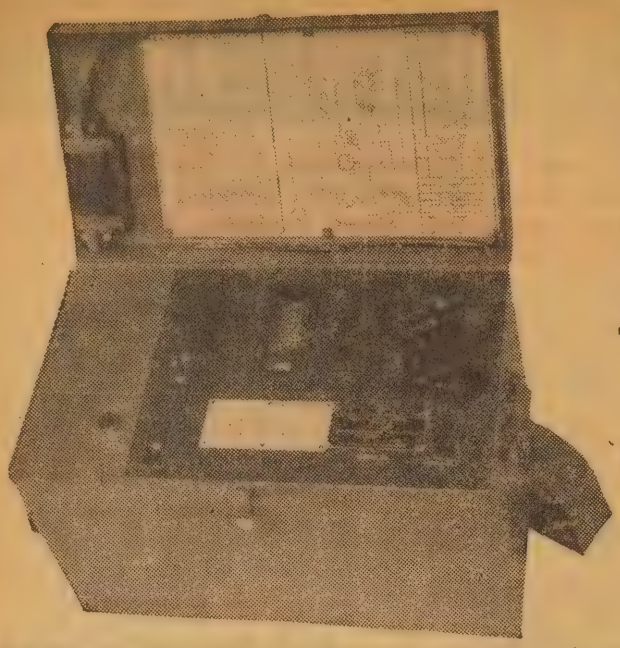
The US amateur during the last few years has seen considerable and varied changes in regulations covering their operation, and judging from general comment they had seen enough changes for the present. The board considered there was a strong sentiment among members and amateurs, that the FCC should provide a breathing spell from its continued series of proposals for changes in amateur rules—hence not one suggestion on the subject was considered at the meeting.

W.I.A. NEWS

THE South Western Zone of the NSW Division of the WIA will conduct their convention at Wagga on the week-end, October 31 and November 1. Zone officer Jim Eagling, VK2AJO, is in charge of the organisation, while Alf Move, VK2BW, of Wagga, is making the necessary local arrangements. Full details of the program will be available at a later date.

Lecturer at the August meeting of the Hunter branch WIA was Phil Levenspill, VK2TX, of Wyong. Phil covered the most interesting part of his recent world trip, his associations with American radio amateurs. Illustrated by means of 16mm film, it showed the origin of many a Californian KW.

With the transfer of Bert Beresford, VK2ABB, manager of the NSW WAIS civil defence emergency net to Melbourne. Bob Winch, VK2OA, takes charge of the operation of the net.



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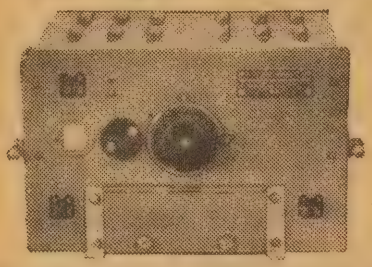

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NSW WIA Sunday VK2WI broadcasts in recent months have been transmitted from various parts of the State with the president, Jim Corbin, VK2YC, visiting the different country zones. Normal Sydney broadcasts are radiated by VK2YC on 7146 Kc/s, by Harry Solomons, VK2AJZ, on 144 Mc/s, and by Allan, VK2ACC, from Heathcote, south of Sydney, on 3600 Kc/s. The 3.5 Mc service is a re-broadcast of VK2AJZ's transmission on 144 Mc/s arriving over a 20-mile path, and allows such a transmission to be made from an excellent location without the problems of BCI in more settled areas. With 7 Mc propagation conditions in their present state, the 3.5 Mc broadcast is essential to effect anything like effective State coverage.

The special VK2WI UHF broadcasts at 2000 hrs EAST, Sundays, are presented on the 50 and 144 Mc bands. Broadcasts are either originated or relayed on these bands by VK2ANF, VK2OA, VK2APQ, VK2AJZ, VK2HE, VK2QZ or VK2HO.

Angus Robertson, VK2IQ, lectured at the July general meeting of the NSW division, his subject, "BCI, its cause and prevention," giving those in attendance plenty of hints to cure present or future BCI problems. Angus also presented the July technical talk over VK2WI, explaining the features of the ionospheric prediction charts for the amateur bands published each month in Amateur Radio.

Two very experienced amateurs resigned from the NSW Divisional Council during July. They were the secretary for a number of years, Dave Duff, VK2EO, and past president Wal Nye, VK2XU. These two gentlemen have served the institute, and amateurs generally, faithfully over a number of years and their work is greatly appreciated.

Bill Lewis, VK2YB, ex 6YB, fills one of the vacancies and his experience in the hobby dates back to the early 20's.

Hec Harvey, VK2ACI, is the newly-elected treasurer, a position requiring considerable use of his so-called "spare time". Hec is a comparative newcomer to the amateur ranks but takes over the position with the desire to keep the finance on the right side of the ledger.

Discussion at the August meeting of the NSW UHF section was again centred around mobile and portable operation. Transmitters was the subject on this occasion, and secretary Harry Solomons, VK2AJZ, opened the discussion by presenting a lecturette on this portion of equipment in the field. A general debate followed.

The committee to assist chairman of the civil defence emergency net, Bob Winch, VK2OA, was elected, members comprise John Moyle, VK2JU, Chas Fryar, VK2NP, Cliff Lamb, VK2LG.

DX AND PERSONAL

Len King, VK2AOK, of DCA, will shortly become a VK9—a good one, too—as he will journey to Norfolk Island. It is hoped Len will be very active to keep the island on the DX map.

VKIBJ and VKIHM are very active from Cocos Island and have been operating CW around 14050 Kc/s. Generally they can be heard during daylight hours on the weekends.

W7MSB is the most consistent American CW station on the 80 metre band. He can be heard most evenings using 800 watts to a Rhombic pointed on Australia.

Bill Storer, ex VKIBS, of Macquarie Island, now of Muswellbrook, is the operator selected to journey with the party to the Antarctica Continent next summer. They will be away for 12 months and the DX minded hope Bill will be able to take away enough equipment to put in an appearance on the amateur bands. Antarctica is a rare country and it is certain he will be the centre of much activity. Bill's current call is VK2EG.

Alf Moye, VK2BW, holidaying on the south coast of NSW has been operating mobile on 80 metres using a centre loaded 9ft whip antenna. Using a type A, Mk III, plus modulator, he has been contacting stations more than 100 miles away in daylight.

W2PEO promises to be on 80 metre CW daily around 2000 hrs EAST, he was running S7 early in August and contacts ZL3RQ, the latter running only 20 watts.

Although Jack De Cure, VK5KO's, return to amateur radio was prophesied by Ray Jones, VK3RJ, the reason for his re-entry into the ranks is quite novel. Jack was implored by a number of SM's to provide an Oceanic contact for their 3.5 Mc WAC's. SM4GL reported that previous schedules with VK stations were unsuccessful. Relenting on his previous decision, Jack obliged the SM's, and provided them with the necessary contacts, but reports propagation conditions in the mornings were not as good as four years previously. North American stations in the evenings were, however, easier to contact.

The long promised operation of CEQAA from Easter Island in the Pacific some 2000 miles west of South America, finally occurred in early August. Signals rather weak, RST 448, were first heard here on August 8 and 9 from 1000 hrs EAST, onwards.

Operating on 14005 Kc/s CEQAA conacted stations up to approximately 14040 Kc/s. The low end of the band was a squealing mass of signals for hours on end. At the start an excellent example of a VFO attack was in progress, but operators at CEQAA gradually forced stations up the band. Still an odd station came up on their frequency with a blind call. Operators on Easter Island kept their contacts short, so short at times, that calling stations were confused.

An odd call for CEQAA was sufficient to start the din off again despite the fact that he had closed down some time ago.

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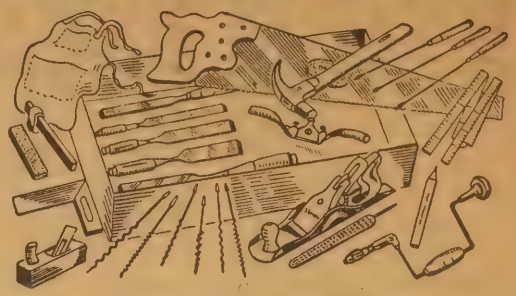

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15 x 18	£9/13/6
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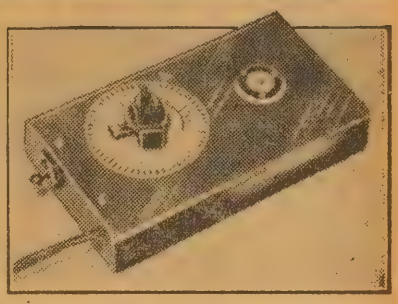
A GREASE SPOT PHOTOMETER

In last month's issue, Mr. Watson outlined the types and uses of photometers as an aid to successful enlarging. For those who may like to experiment, here is a description from an English contributor of a grease-spot photometer. At the end of the article, Mr. Watson adds a few hints based on his experience with photometers of this type.

BY W. L. PEACOCK



The completed grease-spot photometer.

THE instrument described below is similar to a commercial grease-spot photometer, and can be constructed for little outlay by the average home mechanic, as, no doubt, most of the required components will be found in the oddments box.

Basically, it consists of an electric bulb fixed below a grease-spot, the brightness of the bulb being regulated by means of a variable resistance.

If such a system is placed beneath another light source, the grease-spot will either appear light against a dark background, or dark against a light background, depending upon whether the upper light source is weaker or stronger than the lower one.

MATCHING LIGHT

By altering the brightness of the lower source the grease-spot fades into the background, and, at this point the relative intensities of the two sources are equal. Hence, it is possible to measure the intensity of the upper source.

To obtain as great a sensitivity as possible, the range of brightness controlled by the variable resistance should be spread over as great an arc as possible.

This is arranged by choosing a value for the fixed resistance such that it cuts down the brightness of the light to about the greatest that will be required for normal enlarging purposes, and using a variable resistance of such a value that it dims the light to almost zero over an arc of about 180 degrees.

This represents an exposure range of about 30 minutes on the final scale prepared for the instrument.

The values of the resistances; 10 ohms for the fixed, and 25 ohms for the variable one are not claimed to be the most effective, but gave in the original instrument a fairly long scale, as mentioned in the previous paragraph, when an initial voltage of about five volts was used.

BLUE FILTER

The blue filter was included to compensate for the greater percentage of red light emitted by the low voltage bulb compared with the normal enlarging bulb, and also to enable the balance point to be arrived at more easily.

The actual filter used, was the pale blue compensating one supplied with Dufay-color, but a piece of celluloid tinted with photo tints or a square of blue gelatine (1½ exposure as used in portraiture) may be purchased.

If the photometer is to be used in conjunction with a voltage control unit the switch may be omitted, it only being necessary if a bell transformer is used direct on to the mains.

The grease-spot itself is made by dropping candle-grease on to a piece of art paper and scraping off the excess grease. It is better to prepare a few such spots on one piece of paper and to retain and use the best specimen, which should be about 1-8in dia. and symmetrical.

CONSTRUCTION

A celluloid ring and disc as shown in Fig. 1 are prepared and after painting one surface of the ring black, the three parts are cemented together, as shown.

The filter mount is of card and the same size as the ring used in the grease-spot assembly.

As the card is opaque, and mounted close to the bulb, it serves to restrict the beam of light reaching the grease-spot.

The wooden base and ends and the aluminium top and sides, were given a coat of black cellulose after being drilled to take the various components.

To save space the bulb-holder was dismantled, only the threaded portion the soldering tags and the insulated spacing washer being retained. These parts were then fixed to one end with a wood screw, as shown.

The other components can now be added, care being taken to adjust the height of the filter, so that it is just above the bulb.

The switch, if used, fixed and variable resistance and bulb are now connected in series, the leads being taken direct to the voltage control unit or the bell transformer.

It will be noted that a lug has been soldered to the locking nut of the scale to ensure ease of locking.

The photometer as described here originally operated from dry batteries, but if an AC mains supply is available it may be connected to this via a suitable bell transformer.

CONTROL UNIT

The control unit, Fig. 2, consists of a 10 ohm variable resistance, a voltmeter fitted with a plain scale with a mark at about 5 volts, a switch and a 6-volt dry battery. An Eveready 6-volt battery, No. 996, will supply current for this instrument for a few years before its voltage drops to the minimum required for its accurate operation.

In practice, the power supply is switched on and adjusted to the mark by means of the variable re-

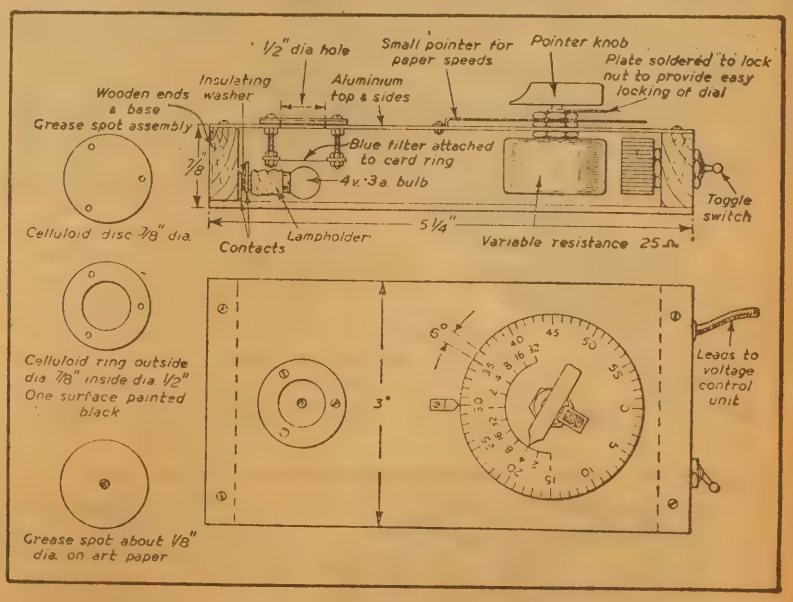


Figure 1 (left) shows details of the celluloid disc and ring. Figure 3 (right) is a sectional elevation and plan view of the grease-spot photometer.

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INTERCHANGEABLE HEAD TYPE. Designed for use with the standard 78 r.p.m. or 33 1/3 r.p.m. long playing microgroove records. To meet these differing requirements interchangeable slide-on heads or cartridges are available. There is definitely nothing comparable with this pick-up.

It is new in pick-up design, has 20 times greater output than comparable magnetic types, and automatic bass response while needle talk and motor rumble are practically non-existent.

Price £8/5/9
INCLUDING BOTH STANDARD & LP CARTRIDGES

The Acos Model HGP.34 Turnover Type Pick-up is fitted with the new and radically different HGP33 crystal cartridge. Output nominally 1 volt on standard records and ¼ volt on L.P. records. The response characteristic is smooth with no resonance. (Data sheet gladly forwarded on request.)

Price £5/17/6
INCLUDING CARTRIDGE

The Acos GP.30 turnover head type pickup is fitted with two separate sapphire styli, one for standard and one for microgroove records, either of which can be placed into operating position by a simple turn of a knob at the front end of the pick-up arm. The knob is clearly marked to show which stylus is ready for use.

"Acos" CRYSTAL CARTRIDGES

(for GP.20 Standard) GP.19 **£2/19/9**

(for GP.20 microgroove) GP.19L.P. -- -- **£2/19/9**

(for GP.30 Turnover) GP.29 **£2/19/9**

(for GP.10 Standard) GP.9 **£1/11/6**

(for HGP Turnover) HGP.33 **£3/17/6**

The HGP.33 crystal cartridge is a high compliance cartridge which is used in the Model HGP.34. The salient points of this cartridge are:— Extremely high compliance and low mass; Completely hermetically sealed crystal unit; Universal mounting.

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stance when the variable resistance in the photometer is fully out circuit, i.e., the lamp is at its ightest.

It could equally well be set with e resistance fully in the circuit, so ng as this procedure is always lopted.

The method of calibration is to se the height of the enlarger head ove the easel and the iris to obtain series of light intensities one-half the previous one. The spot is alanced out for each setting and ie position of the knob marked on dummy scale.

Prepare a dummy scale (2in dia) nd attach to the photometer, lockg it in position with the lock-nut rovided; replace the pointer knob.

Set the voltage control unit as aleady described and, with the enrger head in the lowest position in hich it is used in practice, open ie lens to the first "whole" stop umber and throw slightly out of ocus.

IRST CHECK POINT

Place the photometer in the centre f the easel and balance the two ght sources by moving the knob ntil the grease spot is not visible gainst the background.

Under these conditions the intenity of the light from the enlarger ill never exceed that used in practice, as with a negative in position ven in the highlight there will be ome cut in the intensity.

If a bulb of higher voltage is subtituted later, however, it may not e possible to balance the spot with he head in this position and the lens ide open.

Care must be taken to ensure that series of stops are used which ill give half the light intensity of he previous one.

Two methods of marking are in eneral use, the English and Continntal, a suitable series of stops beng 2.8, 4.0, 5.6, 8, 11, 16, 22, and .2, 4.5, 6.3, 9, 12.5, 18, 25, respecively. If any intermediate values re employed, the scale about to be repared will not be linear.

When balancing out the spot for ach setting of the light intensity it s desirable to approach the balance oint from each side in turn, and to ake the average value as the actual oint recorded.

After marking the first point, close he lens one whole stop and balance gain; continue until the lens is fully losed.

ECOND STAGE

Next, reset the pointer back one livision and, opening the lens to the riginal stop used, raise the enlarger ead until a balance is obtained, lose the lens one stop and rebalance, roceed as previously described until bout 12 points have been made.

By setting the pointer back one livision before rebalancing by raisng the enlarger head, it is possible o check the accuracy of the last nark.

When a sufficient number of points ave been recorded, remove the cale, draw radial lines through each nark and measure the angle subended by each pair.

Total and average the results. Any leviation from the average is due o the non-uniformity of the variable esistance employed.

Next prepare on a piece of plain ard and mark off 6 deg intervals long its edge, so making 60 divisions, which will eventually be used as paper speeds; number as shown in Fig. 3.

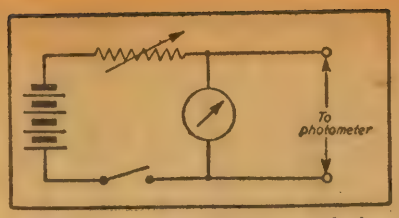

Figure 2: A circuit diagram of the control unit.

Using the average angle subtended by each point on the dummy scale, mark off a concentric scale in such a position that the pointed knob is just in line with it, and number the points 1, 2, 4, 8, 16, 32 (secs), 1, 2, 4, 8, 16 (mins), as shown in Fig. 3.

Cement the finished scale between two pieces of celluloid and fix it to the photometer.

The speed of any type or batch of paper is determined as follows:—

Set up the enlarger with a negative most suited to the type of paper whose speed is being determined, and make an accurate test strip, using the middle tones of the negative.

Develop, wash and fix in the usual way, and decide the correct exposure by examination of the strip in white light.

If a test strip holder of the type which exposes a small square of a piece of paper, in turn in the same position each time, is available, the calibration will be all the more accurate, as there can be quite a variation in tone along a large test strip.

Alternatively, test strips of the shadow and highlighter can be prepared and the average exposure used.

FINAL CHECK

Now place the photometer on the easel in the position occupied by the test strip at the portion of it which was correctly exposed; balance out the spot. Leaving the knob in this position, unlock the scale and rotate until the correct exposure required is in incidence with the pointer, then lock the scale.

The paper speed may now be read off against the pointer on the outer scale.

To obtain the correct exposure for any other negative printable on this paper, take a reading on the middle tones or an average with the dial set at this particular speed, and read off the exposure required

(Continued on Page 99)

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GLUCK—L'IVROGNE CORRIGE—	"	"	1	"
MAHLER—Des Knaben Wunderhorn	"	"	2	"
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(D) Coaxial Cable beaded insulation, tinned copper braid and lacquered cotton outer insulation, approx. 70 ohms impedance, yard 2/-
(E) Heavy 2 Core Shielded Cable rubber cab tyre interior, empire taped and tinned copper outer braiding. Will stand high voltage, yard 2/-
(F) Medium 2 Core Shielded cable rubber insulation empire-taped and tinned copper outer braid, yard 1/3
(G) Light 2 Core Shielded cable rubber insulated empire taped and tinned copper outer braid, yard 1/-
(H) Heavy single Core shielded cable rubber insulated, empire taped with tinned copper outer braid, yard 1/-
(J) Light Belden single Core shielded cable with lacquered woven cotton outer insulation. Ideal for microphone cable, etc., yard 9d.

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OUR PRICE £4/19/6
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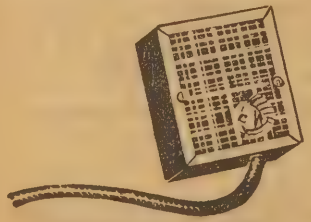

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GP 19 GP.9 G.33

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G.P.29 Acos Cartridge suits GP30. Pick-up for Microgroove and Standard Recordings, price £2/19/9.

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A Grease Spot Photometer

(Continued from Page 97)

gainst the pointer at the balance oint.

The comparison of the contrast ange of a negative with that of vailable papers enables the most itable grade to be chosen.

The contrast range of the negative determined by taking a highlight nd shadow reading and expressing ie results as a ratio:—

Highlight reading 10
Shadow reading 480
Contrast range .. .. 48 : 1

To determine that of paper, raise ie enlarger head high up on the olumn, stop down the lens slightly nd throw out of focus.

Using this dim light source, place strip of paper on the easel and repare a grey scale, each section eceiving twice the exposure of the revious one: Ex. 5, 10, 20, 40, 80, 60 and 320 sec may be used.

Develop, rinse and fix the test rip.

The ratio of the exposure required or the last pure white divided into iat required for the first pure black ives the contrast range of the paper.

Contrast range:—

Maximum exposure for pure white.

Minimum exposure for pure black.

OUR COMMENTS

Much of the success of the above evice depends on the constructors bility to make a satisfactory grease pot. The idea of using candle grease ppears to be quite a good one and as the advantage that it will remain uite stable once the wax returns to oom temperature.

One important point appears to be ie thickness of the paper used. 'hin paper produces the most satis- actory spot but has the disadvan- age that the light on the under- ide will shine through it, making n accurate match difficult.

Thick paper or light card is free rom this objection but does not roduce a satisfactory spot. This is ue to the grease setting before it an penetrate the paper completely nd is difficult to avoid. Warming he paper is not satisfactory because, s the grease penetrates to the other ide, it also spread outwards, result- ng in a spot which varies in density rom the centre to the outside.

Another point is the surface of he paper. Although art paper is pecified the type with a white lossy surface (similar to the cover f Radio and Hobbies), appears to e unsuitable. This is because the namel used to provide the surface s different in color from the paper ase. As a result the spot will al- vays differ in color from the sur- ounding surface and a complete natch is impossible.

As well as the candle grease idea here have been many other sug- estion from various experimenters as to the best method of making the pot. Some of these ideas may nterest the reader who cares to ex- eriment.

One suggestion is to use light nachine oil, but this has the disad- vantage that it spreads and forms much larger spot than required. The artist's medium known as negilp is supposed to be free from his disadvantage, though it may be difficult to obtain, being seldom used these days.

Another scheme which works well is a small clean hole punched in a piece of card and covered with a piece of translucent tracing paper. When this is used it is important that the inside of the case be paint- ed black. It is also important that there be no space between the paper and the card, and this requireemnt is sometimes difficult to satisfy.

What appears to be the most satis- factory arrangement, and which forms the basis for some commercial units, is simply a small blob of white paint on a piece of ground glass. When illuminated from the front this appears white but, because it is opaque, it appears dark when illu- minated from the rear.

For this reason such a spot works "back to front" compared with a real grease spot, appearing dark when the light behind it is greatest and light when the light in front is greatest. However, this is of no con- sequence, since the important point is the ability to balance the two lights

APPROVED METHODS OF WIRING

(Continued from Page 75)

in Fig. 6. The tip should be dressed frequently with a file and tinned while still bright only on the surface indicated in the drawing. The re- maining parts of the tip should be allowed to oxidise.

An iron tinned in this manner can be used in close places where it is necessary for it to touch other con- nections without flowing them since the oxide acts as a heat insulator.

The tinned portion of the solder- ing iron tip should be wiped on a canvas or leather pad attached to the soldering iron stand before each use. This removes excess solder and "slag" and delays erosion of the tip. This operation greatly improves the quality of the job.

In the actual mechanics of solder- ing a connection, the professional wireman does not apply the solder to the iron and transfer it to the joint being soldered. Little flux reaches a joint soldered in this man- ner.

Instead, the well-cleaned iron is applied to the junction of the wire and terminal until both have been heated to near the soldering tem- perature. Then the solder is applied between the iron and the connection until it flows freely around the junction.

A rotary motion of the wrist which "rocks" the iron tip on the joint will serve to work the solder into the joint. The finished connection should be rounded and smooth and the solder should have a bright, shiny appearance.

If the joint is disturbed before the molten solder has solidified, the solder will look dull and "sugary" and must be melted again.

After the wires have been con- nected, the leads are dressed to im- prove the appearance of the wiring job. The insulation of each wire is pushed up against the terminal so that no exposed wire is visible. A small amount of slack is left in each wire to facilitate future reconnecting and to remove tension from the soldered joint.

Before a newly wired circuit is placed in actual operation, it should be subjected to both a visual and electrical inspection so that any wiring errors can be eliminated be- fore the application of operating voltages causes damage to circuit components.

The first inspection should consist of a thorough visual examination of the wiring to detect shorts caused by blobs of solder or loose wire ends between terminals, poorly soldered joints, broken wires or terminals, &c.

When such defects have been rec- tified, the circuit should be given an electrical continuity test with an ohm-meter or lamp or buzzer tester. Short circuits between wires and to ground should be tested for as well as electrical continuity between points indicated as common on the circuit diagram.

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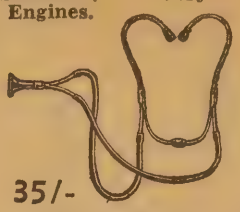

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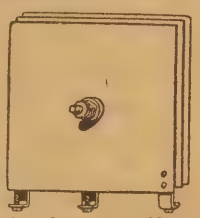

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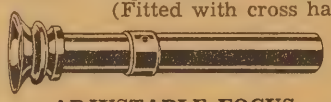

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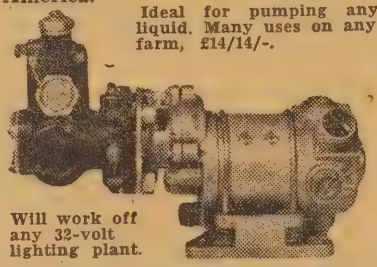

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6 volt. Carry one in your car.

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Fitted with brand new English Selenium Rectifier.

Works off 230v. Household supply.

Charges any battery from 2 to 6 volt at 4 amps. .. .. .. £6/15/- complete
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2.2 cubic feet, will pump up to 751b

Never before at this price. Ideal for Spray Painting

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Will work off ¼hp Motor.

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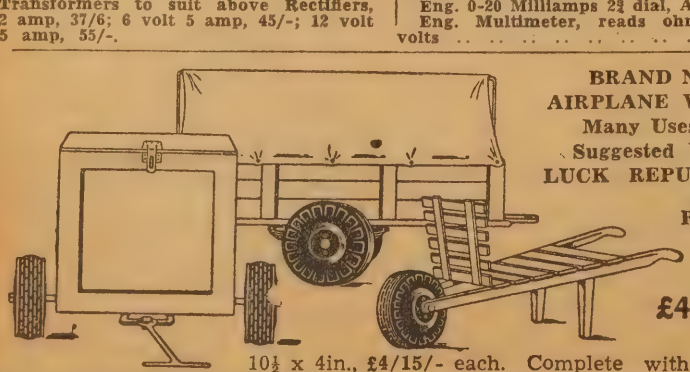

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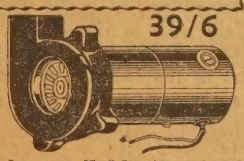
RAF Leather Flying Helmets, 35/-, Speaking Tubes, 50/-. RAF MK8 Goggles, 48/6. MK7, 37/6. Flying Boots, wool lined, £5/19/6 pair. Stock and Die sets, ⅛in, ¼in and 1in water pipe, £4/19/6. English double-ended spindle ¼hp 230 volt motors, capacitor start, worth £1⁸/18/-, £12/12/-. Canvas Tool Rolls, ideal for the car 8/6.

SPECIAL OFFERS

Generator Test Meters, 35-0-35 mp meters, 4½in dial, 45/-; 0-10 olt meters, 4½in dial, 45/-. oading Resistors can be supplied to make meter read 10.20 t 12/6. Medical Scalpels, many ses, photographers, etc., 6/6. Twist Drill Sets, 1/16in to /16in in 9 drills for 6/9; /16 to 7/32in, 7 drills for 6/9, haded Pole induction Motors, nade by Hoover of England, 230 volts, AC. Ideal for Projectors, Tape Recorders, Fans tc., £4/19/6. Inspection Mirors, ideal for Mechanics, 5/9. Tapped Transformers, 6, 12, 18 nd 24 volts, 3 amps, 39/6. 230 olts input. Low pressure Spray Guns, 39/6. American Feeler Gauges, 8/6. Army Steel Tow Ropes with looped ends, 17/6. Army Tripods for photographic work, levels, etc., 41in long, 22/6 ach. Whitworth Spanner Sets, pen one end, ring the other, 5/-, 6 spanners to set. English Hair Clippers, first-grade quality, 7/6 pr. SAE open end Spanners, 6 to set, 24/6. Whitworth, to set, 18/6. 2½in Paint Brushes et in rubber, special price 10/6. Brand new 7/8in Spark Plugs, uit most old type cars, 2/6 ea. Brand new RAAF Life Jackets, apok filled, 27/6. 4in Calipers, nside and outside, 5/6. Parabolic, Reflector Mirrors, 3½in, 5/-. 10½in, 39/6. Build yourself a spotlight or for photographic work. Bosch Electric Windscreen Wipers, £4/18/6. Steel tool Boxes, complete with lift-out tray, 40/6. Best quality English Carpenter's Saws; 4, 5, 6, 7, 8 and 10 point, 30/-. Watchmaker's screwdrivers, set of 5, 4/9. Tweezers, 6/6 pr. Pin vices, 5/6. Eye Glasses, 8/6 ea. Extra strong double lens eye glasses 15/- ea. Swiss Music Box Units, can be fitted into any box. Make yourself a music box, 30/-.

English Motor and Blower, 24 Volts



39/6

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arger size also available that will ork off 12 or 24 volts, £3/15/-.

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8 1-3 gal. per minute.

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IN FIRST-CLASS ORDER.

DALTON COMPUTERS, IDEAL FOR AERO CLUB, A.T.C., Etc.

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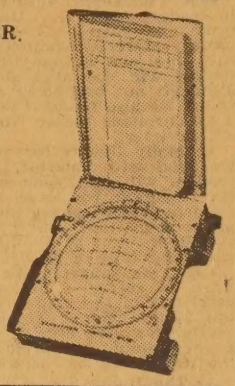

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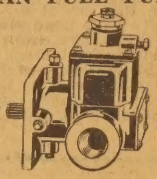
6-volt 37/6 12-volt 25/-
Fitted with Mirror Reflector.

AMERICAN FUEL PUMPS

USED BY THE R.A.F. STAINLESS STEEL VANES



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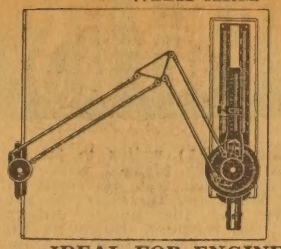

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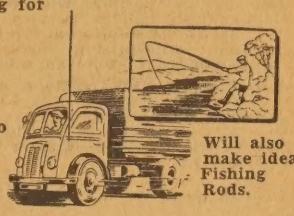

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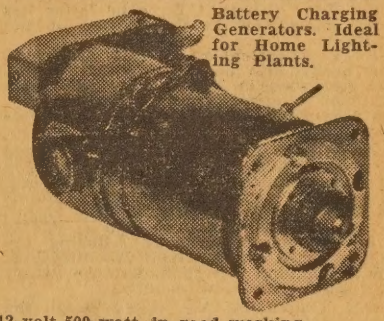
12ft long, 3 sections. Each section 4ft, 22/6, 8ft long, 2 sections, 15/-.



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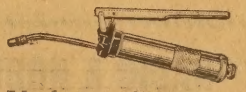

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GENUINE AMERICAN FLYING HELMETS

IDEAL FOR MOTOR CYCLISTS AND ALL OUTDOOR WORKERS.

BRAND NEW,

15/- EACH

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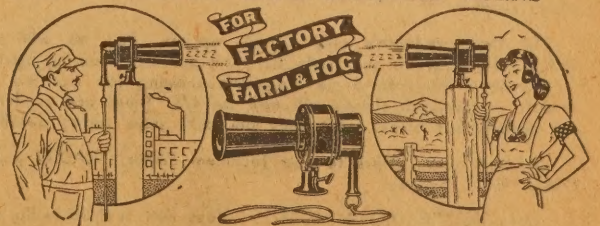
Very loud. Ideal for Trucks, Boats, etc. Useful for Football Timekeepers, etc. BRAND NEW. £4/4/-.



ANSWERS TO CORRESPONDENTS

L.F.P. (Wangary SA) writes to let us know that he is very pleased with the 32 volt receiver which was described in the January 1950 issue. He finds the set very sensitive and the power output adequate for the purpose. However, he would now like to see published some information on vibrator amplifiers for 32 volts.

A: It is very pleasing to have our opinion of the set confirmed by an independent constructor. The secret of success with his set, of course, is a sensitive permag. speaker. We will keep your suggestion regarding the amplifiers in mind. As you say, the position with regard to the phonograph motors is very sticky. There is no simple solution at the moment unless some enterprising manufacturer can be persuaded to take an interest.

G.S.H. (Young, NSW) encloses a circuit for a decade box in which only 4 resistors are required for each bank. Thus, with 6 banks and a total of 24 resistors it is possible to select any value from 10 ohms to 10 megohms.

A: Many thanks, G.S.H., we will keep the idea in mind for the Reader Built It page.

C.B. (Moss Vale, NSW) encloses a couple of queries for the Answer Tom page.

A: Many thanks, C.B., your letter has been passed on to the author of the articles.

P.L.Y. (Cheltenham, NSW) wishes to use headphones only on the Two Valve Set described in the January 1953 issue and also to operate from a 45 volt battery. He asks what alterations would be necessary.

A: In view of the reduced HT voltage it is most likely that the original value of bias resistor will be satisfactory, though you could still try increasing it as suggested. The main thing in a circuit of this kind is to use as high a bias as possible without seriously reducing the output below a comfortable listening level for a minimum distortion. There is plenty of room for experiment here.

C.N. (Yarraville, V.) writes to tell the Serviceman about a recent fault he experienced which was similar to one recently discussed in the Serviceman's column.

A: Thanks for your letter C.N. and we are passing it on to the Serviceman for his possible comment. It is quite possible that the cause of the trouble was the same in both cases, though it would not necessarily have to be the same type of set.

A.W. (Canberra, ACT) encloses a query for "Answer Tom".

A: Many thanks. The letter has been passed on to the author of the articles and will probably be used at a later date.

W.A. (Wickepin, WA) offers suggestions to readers faced with the problem of reproducing microgroove recordings with battery powered equipment. He has found that the old Edison disc-record spring motors will run at a steady 33 1/3 rpm, although not originally designed for this speed. He also found it possible to operate a synchronous motor from a commercial AC inverter.

A: Many thanks for your letter which we read with interest. No doubt many readers will find your suggestions worth investigating. We have not yet had the opportunity of hearing the LP of "Pictures at an Exhibition" but understand that it is well thought of by those who like the particular type of music.

J.H. (Semaphore, SA) is looking forward to seeing a Senior Signal Tracer described in the magazine as a sequel to the Junior Signal Tracer described recently. He also asks if a standard frequency should be specified when quoting the impedance of reactive circuits.

A: The Junior Signal Tracer has proved itself to be such a useful instrument that we have no immediate plans for describing a more elaborate version. If you have need for a signal tracer, we can assure you that you will find the junior version a very useful instrument. It is usual to specify the frequency when quoting the impedance of a circuit containing inductance or capacitance. However, loud speaker voice coil impedances are often quoted without mention of frequency, the impedance at 400 cps being understood. The impedance at other frequencies may be considerably different from the figure quoted.

R.M. (Brisbane) wants to know whether the Little Jim 1953 could be used with a speaker.

A: We would not suggest purchasing a speaker for this set R.M., as it was designed purely as a headphone set. It may be possible to obtain results of a kind in favorable locations but at the best they would not be very impressive. Ideally the speaker should be the largest possible and have the highest available transformer impedance. It should be connected directly in the plate circuit of the outp valve in place of the resistor now used. may be necessary, however, to provide 1000 ohm resistor and a 25 mfd conden in the cathode circuit of the seco triode.

J.H. (Warwick, Qld.) expresses his preciation of the contents of the magaz and the manner in which it is present

A: Many thanks for your interest letter, J.H. We are always pleased receive comment from our readers their reactions to any particular arti or to the contents of the magazine general.

J.W. (Watheroo, WA) is interested the R-J speaker enclosure and wishes to confirm some of the dimensions giv the article.

A: The dimensions given are exac as appeared in the original article fr which it was taken. We have no reason doubt that the figures given are correct

R. W. (Oakleigh, V) has built the mu meter described in the "Learn While Y Built It" series and is puzzled why cannot measure AC current with it.

A: You seem to be a bit mixed up w your current and volts R.W., but we v try to straighten it out. In the first pl there is nothing wrong with your me and the fact that it will not read current is normal. Meters of this ki are not intended to read AC curr due to the difficulties and cost volved in providing this feature, wh is not required very often anyway. Th we find this feature only on the m expensive types. It is true that the res tance of the rectifier increases as current decreases and this is simply natural characteristic of the rectifi Normal resistors are designed to rem constant regardless of current, providi they are not overloaded. However t change in resistance is not the m reason why current cannot be re nor is the resistance of the rectifier serious problem and, in fact, reasona accuracy is possible with the existi circuit on the 0-1 mA range. The trou occurs when higher currents need to read and is caused in the first place the fact that the shunts operate. acr the meter rather than the rectifier, that the rectifier would have to have low enough resistance and sufficient c rent carrying capacity to handle largest current to be read. Shunting rectifier on the AC side would be a bet idea but is still not satisfactory becau of the inductive component in the me coil. The only satisfactory solution is use of a current transformer which carr the total current in its primary windi and passes one milliamp through the me and rectifier from its secondary windi Because these transformers have to very efficient they are fairly expensi and not justified in a simple instrume where they would be used very seldo Your confusion about the effect of rectifier resistance on the current rang and voltage ranges is due to a failure appreciate that, in the case of the volta ranges, the rectifier resistance is only small proportion of the total resistance the circuit, though this would not be if we tried to provide very low volta ranges. In the case of the current rang there is no additional resistance and ev that in the rectifier is undesirable.

J.E.W. (Dubbo, NSW) forwards a su scription and at the same time requests article or articles on multiple speak networks.

A: Many thanks for the subscripti Your cheque has been passed on to t appropriate department. The full bene of a dual speaker network cannot obtained unless a special high frequen speaker is used and unfortunately the are not available in this country at t moment. There is little point in us talki about divider circuits until they do b come available. If two speakers of diffe ent types are mounted together and co nected in parallel in the correct pha without a dividing network, it is possib that you would get a smoother respon because peaks and troughs in individu speakers may tend to average out. would depend on the individual speake We haven't forgotten the amplifier han book.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to others readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

.G. (Christchurch, NZ) is interested the recording amplifier in the May e of Radio and Hobbies and wants know what details are available.

All the drawings which were pub-ed in the original article are avail-and a complete set will cost you (Aust.). This is all the data avail-on this article. The recorder was inally designed for use with a high edance head but it could also be d to feed a 500-ohm head if the out-transformer carries a 500-ohm wind-

.A.S. (Newtown, NSW) wants to know it issues contained details of the tro-Flash unit and mentions a simi-description in an overseas magazine.

The articles covering the Electro-sh unit appeared in the August, Sep-ber, and November, 1952, issues. ies of the circuits are available ough our postal service. We have not n the article to which you refer and we cannot comment on the "Custom lt" characteristic. However, unless makes some worthwhile contribution reduction of size and weight without ucing the light output it would seem be of little interest. At least one of advertisers will construct the Radio Hobbies unit for a small charge r the cost of the components.

.B.D. (Katoomba, NSW) is a keen der of Radio and Hobbies and writes inquire whether we have ever pub-ed constructional details of an emis-n valve tester. If not, he suggests that s would be a subject much appre-ted by readers.

. No, J.B.D., we have not published h an article, though we fully appre-te the need for it. We have inves-ated the position several times but ve always been faced with the prob-n that special components, particularly itches, are required if the circuit is be a reasonably satisfactory one. This kes the position difficult for the me-builder, but we are keeping the a in mind and may yet be able to ercome the problems.

A GUIDE TO TAPE DECK DESIGN

(Continued from Page 79)

Possibly other ways of fixing the capstan will suggest themselves — for example, a flanged bush with grubscrews — but this method is straightforward and satisfactory.

None of the dimensions are critical. For instance, the spindle could equally well be 3-8in diameter if this were more convenient. Naturally the capstan diameter will be chosen to give the required tape speed; for 7½ i.p.s. at 78 rpm it will be as close to 1.836in as possible.

A masonite capstan is worth trying. Glue two or three pieces of masonite together, slightly larger than the required size, to give a total thickness of about ½in. Clamp them tightly together until the glue is hard, and then turn the whole thing to the correct size and drill the centre hole at the same time.

(To be continued.)

ELMEC TAPE RECORDING EQUIPMENT

Tape Deck Type E53

This Deck has proved very popular among amateur and professional users, due to its reliability, ease of operation and attractive finish. The carefully balanced flywheel and accurately machined components ensure wow and flutter free recording.

Note These Features: DUAL SPEED. 3¾in/sec and 7½in/sec: Weight 8½lb: High speed rewind with tape automatically lifting off heads: Two motors included and no external drive necessary: Obtainable with or without Heads. Full or Half Track. With Heads the Deck is complete and ready to connect to an amplifier: Single, conveniently placed control knob

PRICE. Fitted with Elmec High Fidelity Heads. £39/17/6.
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PORTABLE 10 watt "P.A. AMPLIFIER"

POWER TRANSFORMER TYPE — — **PF 170**
Prim 220, 230, 240V. Sec: 285V aside @ 80mA, 6.3V @ 2A, 6.3V @ 2A, 5V @ 2A.

FILTER CHOKE TYPE — — — — — **CF 105**
Prim: 15 Henries @ 100mA.

OUTPUT TRANSFORMER TYPE — — **OP 57**
Prim: 10,000 ohm P.P. Sec: 15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2 ohm.

A.C. OPERATION

"2 BAND TRANSMITTER"
(JUNE ISSUE)

POWER TRANSFORMER TYPE — — **PF 130**
Prim: 240V Sec: 285V aside @ 100mA, 6.3VCT @ 2A, 6.3V @ 2A, 5V @ 2A.

FILTER CHOKE TYPE — — — — — **CF 107**
30 Henries @ 100mA.

"2 BAND RECEIVER"
(JULY ISSUE)

POWER TRANSFORMER TYPE — — **PF 151**
Prim: 240V. Sec: 285V aside @ 60mA, 6.3V @ 2A, 5V @ 2A.

BATTERY OPERATION

"COMBINED VIBRATOR UNIT"
(SEPTEMBER ISSUE)

A. VIBRATOR TRANSFORMER TYPE **PF 107**
Prim: 6V. Sec: 250V D.C. @ 60mA. (Low Radiation).

B. VIBRATOR TRANSFORMER TYPE **PF 104**
Prim: 6V. Sec: 250V D.C. @ 60mA. NOTE. Receiver A only. Transmitter A, B, paralleled.

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Box 2444, G.P.O., Sydney.

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FOR SALE: Connoisseur Three-speed Motor £25. MBH 12in Pickup and Transformer £18. All as new. **XM3712.**

FOR SALE. Complete parts for Car Radio. Best offer. Also other Radio parts. All new. **XL3373.**

FOR SALE. USA National Model NC-125 Radio Receiver 11 tubes, frequency coverage from 560 kilocycles to 35 megacycles. 77 **Tryon Rd., Lindfield.**

FOR SALE: All your turning, drilling, threading, etc., requirements. Ring **XY1900,** outside Bus. Hrs.

FOR SALE: Hornby Electric Train. Gauge O. Everything complete, mostly new. Excellent condition. Best offer. **UM9609.**

FOR SALE: Complete kit of parts to build R. & H. "Vibragram Seven", including Rola G12 Speaker. Bargain, £30. 72 back numbers of R. & H. given Free. **R. Marcus, Hunter St., Glenn Innes.**

FOR SALE: No. 11 set complete £9/10/-. TBY8 VHF Walkie Talkie 28-88mc in 4 bands, 2 spare acorns, new £12. FS6 power supply with spare vibrator, new £5. 813 (2), new, £2 ea. AT10 vibrator power supply, 12v input, 300v 150ma output £3. Responsor receiver VHF 10 valves £3. Morse Code practice set, 2 valves, batteries, 30/-. **J. L. Jones, 21 Eddystone Rd., Bexley. LX1937.**

FOR SALE: No. 11 Transceiver A.C. Xtal Mike, separate modulator. Complete £20/-/-. 25 watt P.A. AMP £25/-/-. New 809 valves 30/- each. **VK2ADO, 93 Campbell Pde., Manly Vale. XU3577. Batley.**

FOR SALE: Electric clock parts. Large quantity, well made synch. wall type. Must sell £16. **FU7479.**

SELL: University model AC/Batt. operated super tester and University model battery operated Oscillator in perfect working order, the lot £16. **LW1568, LA1537.**

SELL: Oscillator B.S.R. Type L.O. 50A, 0-600 cps and 0-16 Kc, low distortion, output meter, 1 watt into 600 ohms, new condition £50. **Hope, 33 Barkly Terrace, Mitcham, Melb. WU1872.**

SELL: Receiver RCA-DZ2, 8 valv (6.3v), converted to 200-230v. A.C., bands 15-1780 Kc, I.F. 90 Kc, B.F.O., 1 F CW peak filter, excellent B'cast "Q5er", £20. **A. Roudle, Lilydale Rd., Ea Ringwood, Vic. WU7005 or MX1159.**

SELL: Record Player. H.M.V. Garra pickup. Arms, 10in speaker 5 valv amplifier. Good tone, suitable studio hall, £17. **Phone UY2471.**

SELL: Palec VCT2 Zenith Osc. Rad parts. Radio Engineers' Handboo Practical Radio Communication. R. & H R. W. others. Wanted enlarger. AR7 re **H. Simmons, Leongatha, Vic.**

SELL: 15 unused valves, 5-7C5, 7-7W 2-7A6, 1-7Z4, 7F7, 7A4. Lot £8. Ri **St., West Merrylands.**

WANTED: Handbook for Bendix MN Radio Compass Receiver. Ring **WX16 or write J. Willis, 40 Leith St., Croyd Park, Sydney.** State price required.

WANTED: One A.L.2 valve. **B. Falcone 56 Meroo Street, Auburn.**

WANTED: Oscillator and daylight d veloping tank outfit. **Morris, P. Ettalong, N.S.W.**

WANTED: Univers or Palec Mod. Oscl lator. MO.1. or Sig. Gen. Microscop mag. 100, 6V. all wave 6 volt vib. se Philips, etc. **A. Taylor, King St., Scott dale, Tas.**

WANTED: W.R.N. Pickup. Domest model preferred. Price, etc., to **Oliphant, 161 Gouger Street, Adelaide, S.**

WANTED: Walkie-Talkie Pack Set. F.M Set No. SCR 300 or BC 1000 preferre Ring **Ryde 1585, A. H. Llewellyn, 425 Blax land Rd., Ryde.**

WANTED: Australian Official Radi Service Manual. Volume 9 and bot volumes 1, State price required. **J. F Maher, Wyalong, N.S.W.**

EXCHANGE. Bendix TA-12B wit tubes, modulator-pwr. supply, les tubes, with circuits and parts list, fo freq. meter, C.R.O., or something usefu in shack. Cash adjustment if necessary Buy good communications rcvs. **Jim Edwards, Rye Park, 2.S.**

A SIMPLE 2-UNIT INTERCOM.

(Continued from Page 35)

plate, screen, and cathode resistors, the cathode by-pass electrolytic, coupling capacitor and 6M5 grid stopper. It also mounts the .05 megohm decoupling resistor and one end of the decoupling electrolytic.

A three- terminal tag strip mounted alongside serves as an anchor point for the incoming mains cable and also provides an earth for the decoupling electrolytic. A two terminal strip, held by one of the power transformer mounting bolts provides an anchor point for one end of the back bias resistor and the negative end of the first electrolytic.

All earth points to the chassis should be connected together with bare tinned copper wire. It is unwise to depend on the chassis for the return, particularly when a steel chassis is used, due to the possibility of corrosion under the solder lugs causing faulty contact.

The press-to-talk switches are small wafer types slightly modified from the usual style. The modification consists of the removal of the clicker plate and the fitting of a loading spring to keep the contacts normally in the one position. It is a standard line known as series 20, type 22, spring return. The contacts are two pole, two position and, although only one set is used with the circuit in its present form, the extra contacts can be used if it is desire to modify the system for domestic us as suggested earlier.

An indicator light is a useful ad ditional feature, serving as a re minder to turn the unit on at th commencement of the day's wor and to prevent it being left on over night. It is quite simply arranged b mounting a dial lamp on the powe transformer and fitting a small indi cator bezel on the front of th cabinet above the press-to-tal switch.

Finally it is important, as wit all amplifiers, to see that the chass is effectively earthed, either b means of the third pin on the powe point or to a separate water pip earth connection if this is not avail able. This is necessary to remov the last trace of hum.

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